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POWER AND MACHINERY IN AGRICULTURE

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CONTENTS

	Page
Introduction	1
Changes effected by power and machinery	2
Reduction in labor requirements	2
Decrease in relative and actual number of agricultural workers	6
Increase in acreage per farm worker	8
Increase in value of farm power and machinery	9
Increase in available power per agricultural worker	10
Change in fuel and feed requirements	10
Substitution of power for man labor	11
Kinds of power	11
Geographic distribution of power	13
Amount of power developed	21
Choice of power	22
Cost of power	23
Major developments in farm tractors	27
Farm implements	29
Duty of farm machines	30
Appendix:	
Statistics relating to tractors, horses and mules, and certain farm conveniences	31
Literature cited	37

INTRODUCTION

A great many changes have occurred during the past 30 years in the kind of power and the type of equipment used in producing field crops in the United States. In some regions changes from human power to animal power and from animal power to mechanical power have been slow; in other regions they have been rapid. Owing to such variations and to the fact that only in recent years has any adequate record been made of the number, kind, and use of power units and implements on farms, it is very difficult to obtain data that will show with reasonable accuracy the part that power and machinery have played in American agriculture. However, available information does show some very definite trends that may have a decided bearing on future developments.

The data used in this publication have been obtained chiefly from Federal and State reports, from individuals associated with State agriculturel colleges, and from farm equipment manufacturers. A considerable part of the statistical matter presented is based on reports of the Bureau of the Census, United States Department of Commerce,[1] and of the Bureaus of Agricultural Economics and of Agricultural Engineering, United States Department of Agriculture. Lacking definite information in some instances, it has been necessary to make estimates, based on available information, and while such estimates are believed to be representative they should not be construed as positive findings.

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[1] Some of the data had not been published in final form when the tabulations herein were made, and may be subject to minor corrections.

CHANGES EFFECTED BY POWER AND MACHINERY

REDUCTION IN LABOR REQUIREMENTS

Probably the most significant effect of the increased use of power and machinery in agriculture has been the reduction in labor requirements per unit of crop production. Studies made by the Department of Agriculture soon after the introduction of the gas tractor indicated a desire on the part of farmers to reduce the labor requirements in farm operations. The high cost of man labor and the unreliability of transient help seem to have been chiefly responsible for the early efforts made in this direction. Farmers were interested in any new power unit or machine which would make them independent of hired labor and permit the timely performance of farm operations. As a result of such efforts, the man-hours required in the production of some crops have been reduced as much as 50 per cent in some localities during the past 30 years.

Tables 1, 2, and 3 show the effect of improved machinery and mechanical power in reducing hours of labor in the production of wheat, corn, and cotton. In appraising the effect of power and machinery in reducing labor requirements consideration should be given to variations in soil and climatic conditions under which individual crops are grown and to shifts in crop production areas. For example, it is doubtful whether the labor requirements in producing wheat in the Middle Atlantic States where fields are small and cut into irregular shapes by streams, woodland, or hills can be reduced to a point comparable to the labor requirements of the same crop in the Great Plains States where the land is nearly level and fields are large and regular. Similarly, topography, rainfall, and length of growing season account for some of the differences in labor requirements for growing cotton between the Southeastern States and certain parts of Texas.

TABLE 1.—*Approximate labor requirements for major operations in the production of 1 acre of wheat (20 bushels)* [1]

HAND METHODS, ABOUT 1830

Operation	Equipment used	Operators	Power		Man labor
			Horses [2]	Tractors [3]	
		Number	*Number*	*Number*	*Hours*
Plowing	Walking plow	1	2		6.7
Sowing	Sack	1			1.2
Harrowing and covering seed	Brush	1	2		2.5
Reaping, binding, and shocking	Sickles [4]	2			20.0
Hauling bundles to barn	Wagon	2	2		4.0
Threshing and stacking straw	Flail and forks	1			13.3
Winnowing	Shovel, sheet, and measure	3			10.0
Total					57.7

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[1] Figures for 1830 and 1896 based on the thirteenth annual report of the Commissioner of Labor (*23*)[5]; those for 1930 based on U. S. Dept. Agr. Bul. 1198 (*24*); U. S. Dept. Agr. Tech. Bul. 70 (*16*); and estimates.
[2] Oxen used in 1830.
[3] Steam tractor used in 1896; 3-plow gas tractor used in 1930.
[4] With cradle, approximately 10 man-hours required per acre for reaping, binding, and shocking.
[5] Italic numbers in parentheses refer to Literature Cited, p. 37.

Table 1.—*Approximate labor requirements for major operations in the production of 1 acre of wheat (20 bushels)*—Continued

MACHINE METHODS IN CENTRAL WINTER-WHEAT BELT, 1896

Operation	Equipment used	Operators	Power		Man labor
			Horses	Tractors	
		Number	*Number*	*Number*	*Hours*
Plowing	2-bottom gang plow	1	4		2.0
Sowing	Broadcast seeder	2	2		.2
Harrowing and covering seed	Section harrow	1	4		.3
Harvesting	Binder	1	3		.7
Shocking		2			1.3
Hauling bundles to thresher	Wagons	12	16		2.0
Threshing and stacking straw	Thresher and forks	7		1	1.0
Hauling water and fuel	Wagon and barrels	1	2		.2
Hauling wheat to granary	Wagons	1	4		.9
Unloading at granary	Shovels	1			.2
Total					8.8

MACHINE METHODS IN GREAT PLAINS AREA, 1930

Operation	Equipment used	Operators	Horses	Tractors	Man labor
Plowing	3-bottom gang plow	1		1	1.0
Disking	10-foot tandem disk	1		1	.3
Harrowing	6-section harrow	1		1	.1
Drilling	Two 10-foot drills	2		1	.3
Harvesting and threshing	12-foot combine	2		1	.8
Hauling to granary or elevator	Motor trucks	2			.8
Total					3.3

Table 2.—*Approximate labor requirements for major operations in the production of 1 acre of corn (40 bushels) in the Corn Belt* [1]

HAND METHODS, ABOUT 1855

Operation	Equipment used	Operators	Power		Man labor
			Horses	Tractors [2]	
		Number	*Number*	*Number*	*Hours*
Plowing	Walking plow	1	2		5.0
Harrowing	Harrow	1	2		1.2
Marking rows	Shovel plow	1	1		2.5
Planting	Bucket	1			1.2
Covering seed	Hoe	1			2.5
Harrowing	Harrow	1	2		1.2
Cultivating	Shovel plow	1	1		10.0
Husking and hauling to crib	Pegs and wagons	1	2		10.0
Total					[3] 33.6

HAND AND MACHINE METHODS, 1894

Operation	Equipment used	Operators	Horses	Tractors	Man labor
Plowing	2-bottom gang plow	1	4		2.0
Harrowing	Disk harrow	1	4		.6
Planting	2-row planter	1	2		.6
Harrowing	Peg-tooth harrow	1	4		.2
Cultivating	Single-row cultivator	1	2		5.0
Husking and hauling to crib	Pegs and wagons	1	2		6.7
Total					[3] 15.1

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[1] Figures for 1855 and 1894 based on the thirteenth annual report of the Commissioner of Labor (*23*); those for 1930 based on Heitshu (*7*), and estimates.

[2] General-purpose tractors.

[3] Data published by other Federal and State agencies indicate that these figures are somewhat lower than the averages for the whole Corn Belt.

TABLE 2.—*Approximate labor requirements for major operations in the production of 1 acre of corn (40 bushels) in the Corn Belt*—Continued

ALL-MACHINE METHODS, 1930

Operation	Equipment used	Operators	Power		Man labor
			Horses	Tractors	
		Number	*Number*	*Number*	*Hours*
Plowing	2-bottom gang plow	1		1	1.5
Disking	7-foot tandem disk	1		1	.4
Harrowing and packing	4-section harrow and pulverizer	1		1	.2
Planting	2-row planter	2		1	.6
Cultivating	2-row cultivator [4]	1		1	2.0
Husking and hauling to crib	2-row picker and wagons	3	4	1	2.2
Total					[5] 6.9

[4] 3 and 4 row cultivators were available but not widely in use.

[5] Though less than the Corn Belt average, this requirement is greater than the actual on some individual farms.

TABLE 3.—*Approximate labor requirements for major operations in the production of 1 acre of cotton (750 pounds seed cotton)*[1]

HAND METHODS, ABOUT 1841

Operation	Equipment used	Operators	Power		Man labor
			Mules	Tractors [2]	
		Number	*Number*	*Number*	*Hours*
Cutting or knocking stalks	Knife or stick	1			3.0
Bedding land	Walking plow (wooden moldboard).	1	1		8.8
Opening beds	Bull tongue	1	1		2.2
Planting	Basket	1			4.4
Covering seed	Block	1	1		2.2
Barring off	Shovel plow	1	1		4.4
Chopping and hoeing	Hoe	1			27.0
Cultivating	Sweep and harrow	1	1		28.6
Picking	Basket	1			60.0
Hauling to gin	Wagon	1	2		8.0
Total					148.6
HAND AND MACHINE METHODS, 1895					
Cutting stalks	Stalk cutter	1	2		1.2
Bedding land	Walking plow	1	1		8.0
Harrowing	Smoothing harrow	1	1		1.5
Planting	1-row planter	1	1		1.5
Cultivating	Double sweep	1	1		1.2
Chopping and hoeing	Hoe	1			25.0
Cultivating	1-row cultivator	1	2		8.0
Picking	Sack	1			50.0
Hauling to gin	Wagon	1	2		6.0
Total					102.4
HAND AND MACHINE METHODS NEAR CORPUS CHRISTI, TEX., 1930 [3]					
Disking	7-foot tandem disk	1		1	0.5
Bedding land	2-row middle burster	1		1	.6
Harrowing	4-section harrow	1		1	.2
Planting	2-row planter	1		1	1.2
Cultivating	2-row cultivator	1		1	1.3
Chopping and hoeing	Hoe	1			15.0
Picking	Sack	1			50.0
Hauling to gin	Motor truck	1			3.0
Total					[3] 71.8

[1] Figures for 1841 and 1895 based on the thirteenth annual report of the Commissioner of Labor (*23*); those for 1930 based on U. S. Dept. Agr. Bul. 511 (*2*); Texas Agr. Exp. Sta. Bul. 362 (*5*) Jones (*10*); Dept. Bul. 961 (*15*) and estimates.

[2] General-purpose tractors.

[3] Labor requirements in northwest Texas lower than indicated but for other cotton-production areas averages will probably approximate that of 1895.

Table 1 shows the influence of power and machinery in reducing the man labor for producing wheat. The principal reductions in man-hours during the past century have resulted from changes in methods and equipment used in harvesting and threshing the grain. With the sickle and flail approximately 47 man-hours were required to cut, bind, shock, thresh and clean an acre of wheat with a yield of 20 bushels. By the use of a binder and thresher this was reduced to about 6 man-hours. Where conditions are favorable for use of the combined harvester-thresher and of motor trucks for hauling, harvesting, threshing, and storing of the grain can be performed by the expenditure of only about 2 man-hours per acre. The labor requirements indicated in Table 1 for 1830 were probably applicable to all areas where wheat was grown at that time. Those for 1896 applied particularly to the central Winter-Wheat Belt but were generally applicable to areas where self binders and grain threshers were used. The 1930 figures apply generally to the Great Plains area. The methods and equipment in common use in 1830 can still be found in some areas, such as mountainous parts of the East. The methods indicated for the period about 1896, with some modifications, were not uncommon throughout both the spring and winter wheat areas in 1930.

The greater part of the labor required in the production of corn is employed in cultivating and harvesting the crop. With the 1-horse shovel plow mentioned in Table 2 at least 10 man-hours were required per acre for cultivating corn in 1855. By the use of a 1-row riding cultivator this time could be reduced to about 5 man-hours, and with a 2-row tractor cultivator it is not uncommon for cultivations to require only 2 man-hours per acre. The man-hours required in harvesting corn by hand methods depend largely upon whether it is husked from the standing stalk or from the shock. When husked by hand from the standing stalk from 6 to 10 man-hours per acre are usually required for a yield of 40 bushels, including hauling the corn to the crib. With a 2-row tractor-operated corn picker, not more than 2 man-hours are necessary for these operations under favorable conditions. The man-labor requirements as indicated in the table are thought to be somewhat lower than the average for the Corn Belt as a whole in 1855 and in 1894. In some areas the average requirements in 1930 were probably as high as those shown for 1894. The 1930 figures, though less than the Corn Belt average, are greater than the actual on some individual farms.

Power and machinery have not affected the labor requirements in cotton production so greatly as in small-grain or corn production, because of the larger amount of hand labor necessary in chopping, hoeing, and picking. However, from 1841 to 1930 the man-hours required in the production of cotton were reduced at least 50 per cent in some areas. This was accomplished chiefly by the use of improved tillage methods and equipment, and by the opening up of new cotton-production areas where large-scale equipment is applicable. No machine has yet come into sufficiently general use to reduce materially the hand labor necessary in chopping or in picking cotton. The problems involved in developing a successful mechanical cotton picker are doubtless among the most difficult that have confronted inventors and designers of agricultural implements. This is because of the variety of soil and climatic conditions under which the crop is grown, and the physical characteristics of the cotton plant. Despite such obstacles, however, a great deal has been accomplished toward developing a practicable cotton harvester. The labor requirement in cotton production shown in Table 3 for 1841 and 1895 are thought to be representative for the Cotton Belt as a whole. The 1930 figures apply particularly to an area in southern Texas where large scale methods and equipment are commonly used. In northwest Texas the requirements are even somewhat lower than those shown in Table 3. With the additional exception of some farms in the Yazoo-Mississippi Delta area and in some other areas where large scale methods and equipment are used, the labor requirements for the Cotton Belt as a whole in 1930 were probably about the same as are indicated for 1895.

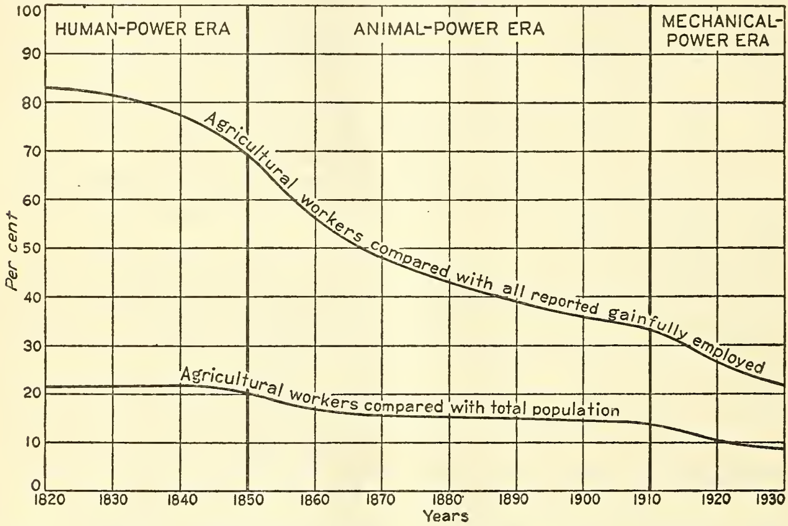

FIGURE 1.—Decrease in proportion of population engaged in agriculture in the United States, 1820 to 1930

DECREASE IN RELATIVE AND ACTUAL NUMBER OF AGRICULTURAL WORKERS

With developments in industry, more and more workers have been needed in cities, and the ratio of agricultural workers to all workers decreased from year to year. Figure 1 shows graphically the changes in the ratio from 1820 to 1930, inclusive. However, this decrease has not continued since 1930. In 1820 approximately 83 per cent of all persons in the United States 10 years old and over, reported as being gainfully employed, were engaged in agriculture. By 1930 only about 21 per cent of such persons employed in all occupations in the United States were engaged in agriculture. Figure 1 also shows that the ratio of agricultural workers to total population decreased from 21.5 per cent in 1820 to 8.5 per cent in 1930.

Table 4 shows, with some exceptions, the total population, number of persons gainfully employed, and the number engaged in agriculture in the United States from 1820 to 1930, inclusive. Census reports show that the number of persons engaged in agriculture increased annually from 1820 to 1910, but this increase was not in proportion to the increase in total population. Between 1910 and 1930, however, there was an actual decrease in the number of agricultural workers. This is shown graphically in Figure 2. Despite the decrease in the number of agricultural workers during this period, there was an increase in both acreage of harvested crops and total crop production.

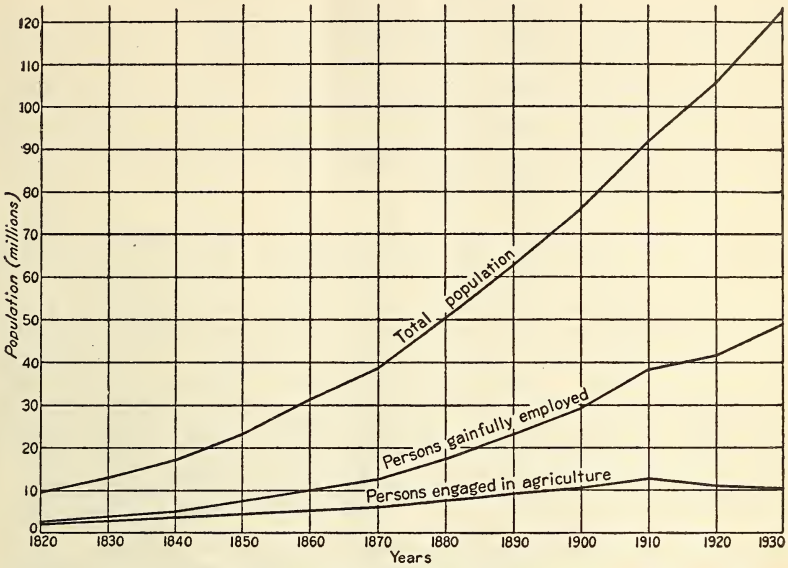

FIGURE 2.—Total population, persons gainfully employed, and persons engaged in agriculture in the United States from 1820 to 1930

The increase in production per worker was due, in a large measure, to the increased use of power and machinery on farms.

TABLE 4.—*Relation of agricultural workers to workers gainfully employed in the United States, census years 1820 to 1930, inclusive* [1]

Year	Total population	Workers 10 years old and over—		Ratio of agricultural workers to—	
		Gainfully employed	Engaged in agriculture	All workers	Total population
1820	9,638,453	[2] 2,490,770	2,068,958	83.1	21.5
1830	12,866,020	(3)	----------	----------	----------
1840	17,069,453	[2] 4,798,869	3,719,951	77.5	21.8
1850	23,191,876	(3)	----------	----------	----------
1860	31,443,321	(3)	----------	----------	----------
1870	38,558,371	[4] 12,505,923	5,922,471	47.4	15.4
1880	[5] 50,155,783	17,392,099	7,713,875	44.4	15.4
1890	62,622,250	[6] 23,318,183	9,148,448	39.2	14.6
1900	75,994,575	29,073,233	10,381,765	35.7	13.7
1910	91,972,266	38,167,336	12,659,082	33.2	13.8
1920	105,710,620	41,614,248	10,953,158	26.3	10.4
1930	122,775,046	48,832,589	10,482,323	21.5	8.5

[1] From census reports. Number of workers not entirely comparable for all years, as early inquiries were limited to certain classes.

[2] Age limit not given.

[3] Data not available.

[4] "Persons engaged in all occupations."

[5] Excluding persons in Indian Territory and on Indian reservations, for which occupation statistics are not available.

[6] See 1900 Census Occupation Report (*22, p. lxvi*) for explanation of adjustments made in 1890 data. See also footnotes under Table 1, 1920 Census (*21 v. 4, p. 33.*)

INCREASE IN ACREAGE PER FARM WORKER

It is estimated that the average agricultural worker cared for about 15 acres of crops before the Civil War. At the present time the average is about 36 acres per agricultural worker, for the United States as a whole, as is shown in Table 5. The average acreage per farm worker in 1930 is not entirely representative of the changes which have occurred, as the increase in number of small farms near industrial cities tends to reduce the average acreage. For some States, however, the average is over 100 acres, as is shown in Table 6. The greatest increase in acreage per farm worker has occurred in the grain-producing areas of the Great Plains States. In those areas, topography, soil, and climate are suitable for large-scale operations, and the amount of labor required per acre of grain is small in comparison with that required for row crops.

TABLE 5.—*Number of farms, agricultural workers, acres of harvested crops and value of power units, implements, and machinery for census years, 1870–1930*

Year [1]	Farms	Agricultural workers [2]	Harvested crops [3]			Value [4] of power units, implements, and machinery				
			Total	Per farm	Per worker	Horses and mules [5]	Implements [6]	Total	Per farm	Per worker
	Number	*Number*	*Acres*	*Acres*	*Acres*	*Dollars*	*Dollars*	*Dollars*	*Dolls.*	*Dolls.*
1870	2, 659, 985	5, 922, 471	----------	-----	------	583, 150, 000	270, 914, 000	854, 064, 000	321	144
1880	4, 008, 907	7, 713, 875	178, 500, 000	44. 5	23. 1	673, 665, 000	406, 520, 000	1, 080, 185, 000	269	140
1890	4, 564, 641	9, 148, 448	234, 000, 000	51. 3	25. 6	1, 230, 358, 000	494, 247, 000	1, 724, 605, 000	378	189
1900	5, 737, 372	10, 381, 765	295. 350, 000	51. 5	28. 4	965, 762, 000	749, 776, 000	1, 715, 538, 000	299	165
1910	6, 361, 502	12, 659, 082	324, 500, 000	51. 0	25. 6	2, 648, 573, 000	1, 265, 150, 000	3, 913, 728, 000	615	309
1920	6, 448, 343	10, 953, 158	363, 100, 000	56. 3	33. 2	2, 728, 481, 000	3, 594, 773, 000	6, 323, 254. 000	981	577
1930	6, 288, 648	10, 482, 323	371, 719, 000	59. 1	35. 5	1, 348, 647, 000	3, 301, 655, 000	4, 650, 302, 000	739	444

[1] Census reports as of June 1, for 1870 to 1900, inclusive, Apr. 15, 1910, Jan. 1, 1920, and Apr. 1, 1930.
[2] Persons 10 years old and over—not entirely comparable for all years due to changes in census classification and dates of enumeration.
[3] Includes double cropping (years immediately preceding census dates); Bureau of Agricultural Economics, U. S. Department of Agriculture.
[4] In current dollars, not indicating accurately the increase in use of power and machinery.
[5] Yearbook, U. S. Department of Agriculture, 1921 and 1931 (*18*), except 1930 from census reports.
[6] Census reports.

TABLE 6.—*Acres of harvested crops, and value of power units, implements and machinery on farms in the United States, 1930*

State	Farms [1]	Agricultural workers [1]	Harvested crops, 1929 [2]			Value of power units, implements, and machinery [1]		
			Total	Per farm	Per worker	Total	Per farm	Per worker
	Number	*Number*	*Acres*	*Acres*	*Acres*	*Dollars*	*Dollars*	*Dollars*
Maine	39, 006	51, 519	1, 311, 298	33. 6	25. 4	35, 885, 084	919. 99	696. 54
New Hampshire	14, 906	22, 091	378. 881	25. 4	17. 2	11, 023, 099	739. 51	498. 99
Vermont	24, 898	38, 141	1, 082, 626	43. 5	28. 4	26, 551, 883	1, 066. 43	696. 15
Massachusetts	25, 598	56, 015	477, 467	18. 7	8. 5	21, 670, 504	846. 57	386. 87
Rhode Island	3, 322	8, 873	55, 229	16. 6	6. 2	3, 126. 209	941. 06	352. 33
Connecticut	17, 195	36, 687	370, 654	21. 6	10. 1	14, 842, 749	863. 20	404. 58
New York	159, 806	267, 979	7. 027, 424	44. 0	26. 2	213, 083, 313	1, 333. 39	795. 15
New Jersey	25. 378	64, 471	782, 172	30. 8	12. 1	32, 068, 216	1, 263. 62	497. 40
Pennsylvania	172, 419	251, 443	6, 662, 513	38. 6	26. 5	197, 231, 930	1, 143. 91	784. 40
Ohio	219. 296	312, 218	10, 464, 334	47. 7	33. 5	156, 976, 754	715. 82	502. 78
Indiana	181, 570	250, 150	10, 685, 167	58. 8	42. 7	129, 230, 904	711. 74	516. 61
Illinois	214, 497	352, 524	19, 822, 762	92. 4	56. 2	232, 449, 262	1, 083. 69	659. 39
Michigan	169, 372	247, 963	8, 007, 586	47. 3	32. 3	148, 747, 295	878. 23	599. 88
Wisconsin	181, 767	290, 134	9, 935, 237	54. 7	34. 2	222, 928, 471	1, 226. 45	768. 36
Minnesota	185, 255	303, 822	18, 626, 423	100. 5	61. 3	247, 385, 372	1, 335. 38	814. 24
Iowa	214, 928	331, 152	23, 132, 221	107. 6	69. 9	360, 827, 113	1, 678. 83	1, 089. 61
Missouri	255, 940	371, 251	13, 725, 942	53. 6	37. 0	149, 326, 029	583. 44	402. 22
North Dakota	77, 975	134, 451	21, 579, 601	276. 8	160. 5	150, 505, 474	1, 930. 18	1, 119. 41
South Dakota	83, 157	130, 786	18, 091, 347	217. 6	138. 3	140, 312, 749	1, 687. 32	1, 072. 84
Nebraska	129, 458	197, 342	21, 819, 923	168. 5	110. 6	198, 062, 821	1, 529. 94	1, 003. 65

[1] Census report. [2] Bureau of Agricultural Economics; includes double cropping.

TABLE 6.—*Acres of harvested crops, and value of power units, implements and machinery on farms in the United States, 1930*—Continued

State	Farms	Agricultural workers	Harvested crops, 1929			Value of power units, implements, and machinery		
			Total	Per farm	Per worker	Total	Per farm	Per worker
	Number	*Number*	*Acres*	*Acres*	*Acres*	*Dollars*	*Dollars*	*Dollars*
Kansas	166,042	229,544	24,485,335	147.5	106.7	211,278,325	1,272.44	920.43
Delaware	9,707	17,341	414,713	42.7	23.9	10,124,185	1,042.98	583.83
Maryland	43,203	84,226	2,310,981	53.5	27.4	38,755,704	897.06	460.14
District of Columbia	104	1,099	1,845	17.7	1.7	112,052	1,077.42	101.96
Virginia	170,610	270,836	4,326,240	25.4	16.0	71,546,194	419.36	264.17
West Virginia	82,641	118,162	1,691,820	20.5	14.3	26,503,042	320.71	224.29
North Carolina	279,708	499,923	6,486,908	23.2	13.0	83,137,925	297.23	166.30
South Carolina	157,931	344,641	4,664,472	29.5	13.5	42,820,015	271.13	124.25
Georgia	255,598	497,716	9,781,724	38.3	19.7	68,148,630	266.62	136.92
Florida	58,966	133,648	1,899,541	32.2	14.2	21,394,284	362.82	160.08
Kentucky	246,499	358,575	5,485,416	22.3	15.3	75,062,785	304.52	209.34
Tennessee	245,657	376,623	6,405,597	26.1	17.0	85,812,211	349.32	227.85
Alabama	257,395	492,818	7,947,740	30.9	16.1	70,256,823	272.95	142.56
Mississippi	312,663	557,402	6,792,462	21.7	12.2	80,758,771	258.29	144.88
Arkansas	242,334	384,612	6,760,359	27.9	17.6	63,965,563	263.96	166.31
Louisiana	161,445	297,239	4,458,748	27.6	15.0	49,867,284	308.88	167.77
Oklahoma	203,866	306,140	15,707,728	77.0	51.3	130,496,284	640.11	426.36
Texas	495,489	842,001	31,164,482	62.9	37.0	284,126,387	573.43	337.44
Montana	47,495	79,678	7,911,879	166.6	99.3	75,904,187	1,598.15	952.64
Idaho	41,674	65,561	3,227,373	77.4	49.2	50,198.044	1,204.54	765.67
Wyoming	16,011	30,827	2,018,128	126.0	65.5	23,035,092	1,438.70	747.24
Colorado	59,956	106,234	6,818,346	113.7	64.2	65,528,970	1,092.95	616.84
New Mexico	31,404	58,971	1,502,430	47.8	25.5	19,305,023	614.73	327.36
Arizona	14,173	38,697	501,229	35.4	13.0	14,306,746	1,009.44	369.71
Utah	27,159	41,283	1,203,005	44.3	29.1	18,511,459	681.60	448.40
Nevada	3,442	8,948	398,057	115.6	44.5	6,615,768	1,922.07	739.36
Washington	70,904	104,294	3,676,392	51.8	35.2	62,132,398	876.29	595.74
Oregon	55,153	82,031	2,954,002	53.6	36.0	53,558,693	971.09	652.91
California	135,676	334,241	6,683,219	49.2	20.0	154,803,705	1,140.98	463.15
Total	6,288,648	10,482,323	371,718,978	59.1	35.5	4,650,301,780	739.48	443.63

INCREASE IN VALUE OF FARM POWER AND MACHINERY

Reports issued by the Bureau of the Census give the value of implements and machinery on farms in the United States. Prior to the introduction of mechanical-power units, these figures, with some exceptions, represented the value of what is generally considered as farm implements. For later years the figures include also the mechanical-power units such as tractors, trucks, and automobiles. Since the available information is insufficient for separating the values of the implements and the power units, the value of horses and mules on farms, including breeding stock, has been included in the figures for value given in Tables 5 and 6.

Table 5 shows that the value of power and machinery per agricultural worker has increased from approximately $144 in 1870 to $444 in 1930. Automobiles probably comprised at least 20 per cent of the value of power units and machinery on farms in 1930. While the automobile is not considered as a source of power for farm work, the expenses involved must be borne by the farm. If mechanical power is to be used to best advantage, it must either replace more animal-power units or must be more effectively coordinated with animal power. Such changes may be expected to occur, as improvements are being made in the design and construction of mechanical-power units that will make them more reliable and adaptable to a greater variety of uses. There is also a tendency to develop certain classes of farm machinery that will combine two or more operations and thus reduce the investment in equipment for performing the operations. The most notable example of this is the combined harvester-thresher. The initial cost of a combine is usually less than that of the harvesting and threshing machinery which the combine will replace.

INCREASE IN AVAILABLE POWER PER AGRICULTURAL WORKER

In 1850 an average of approximately 1.5 horsepower was available for the use of each agricultural worker in the United States. By 1930 the average had increased to about 6.7 horsepower. This increase in available power resulted in an increase in total crop production per agricultural worker, though the increase in production was not generally proportional to the increase in power. However, in some areas the increase in crop production was greater than the increase in power per worker. The most serious difficulty encountered in utilizing power on farms is the extreme seasonal demand, which results in inefficient utilization of individual power units.

CHANGE IN FUEL AND FEED REQUIREMENTS

With the decrease in number of work animals on farms and the increase in the number of mechanical power units, there naturally has been an increase in the consumption of fuel and a decrease in the consumption of feed for work stock. The number of work animals on farms in the United States was probably greater in 1918 than in any previous or subsequent year. The decrease in number of horses and mules on farms from 1918 to 1930 has released for other uses than growing feed for work stock an area of crop land that has been variously estimated at 15,000,000 to 25,000,000 acres. During the same period the consumption of petroleum fuels on farms probably increased over 100 per cent. Table 7 shows that in 1930 over 2,000,000,000 gallons of petroleum fuels and approximately 91,000,000 gallons of lubricating oil were used on farms in the United States.

TABLE 7.—*Estimated consumption of fuel and lubricating oil in internal-combustion engines on farms in the United States, 1930*

Power units			Horse-power-hours developed	Fuel				Lubricating oil used
Kind	Number	Average size		Kind	Weight		Amount used	
					Per horse-power-hour	Per gallon		
	Thousands	*Horsepower*	*Thousands*		*Lbs.*	*Lbs.*	*1,000 gallons*	*1,000 gallons*
Stationary gas engines:								
Small	1,118	2.50	559,200	Gasoline or kerosene	0.75	6.5	64,523	[1] 3,226
Large	13	18.82	240,000	Gasoline, kerosene, or distillate.	.75	7.0	25,714	[1] 1,286
Electric-light plants	270	3.00	129,760	Gasoline	1.00	6.0	21,627	[1] 1,081
Gas tractors:								
Drawbar work	920	11.95	2,530,000	Gasoline, kerosene, or distillate.	1.00	7.0	361,429	[1] 18,071
Belt work	920	23.90	1,540,070	do	.75	7.0	165,007	[1] 8,250
Harvester-threshers	61	37.20	169,500	Gasoline	.75	6.0	21,188	[1] 1,060
Trucks	900		(2)	do	(2)	6.0	225,096	[3] 11,255
Automobiles	4,135		(4)	do	(4)	6.0	1,240,500	[5] 46,519
Total							2,125,084	90,748

[1] On basis of 1 gallon of oil for each 20 gallons of fuel.
[2] Estimated use 2,500 miles per truck, with fuel consumption of 1 gallon per 10 miles.
[3] 50 miles per quart of oil.
[4] Estimated use 4,500 miles per car, with fuel consumption of 1 gallon per 15 miles.
[5] 100 miles per quart of oil.

SUBSTITUTION OF POWER FOR MAN LABOR

As a source of power, a 1,200-pound horse is equivalent to about eight 150-pound men. On this basis, and with man labor and horse work each valued at 20 cents per hour, the muscular energy of a man costs $1.60 per horsepower-hour, as compared with 20 cents for that of a horse. That a man's time is worth more in some other capacity than as a source of power was recognized at an early date, but not until about 1850 did the use of animal power in agriculture greatly influence the number of agricultural workers required per unit of crop production in the United States. Although mechanical power was used on farms before the Civil War, such power units had very little influence on the number of agricultural workers required per unit of crop production for the country as a whole until about 1910, except possibly as the steam engine was used for plowing and grain threshing. Mechanical power apparently had little influence on the number of work animals on farms until about 1920.

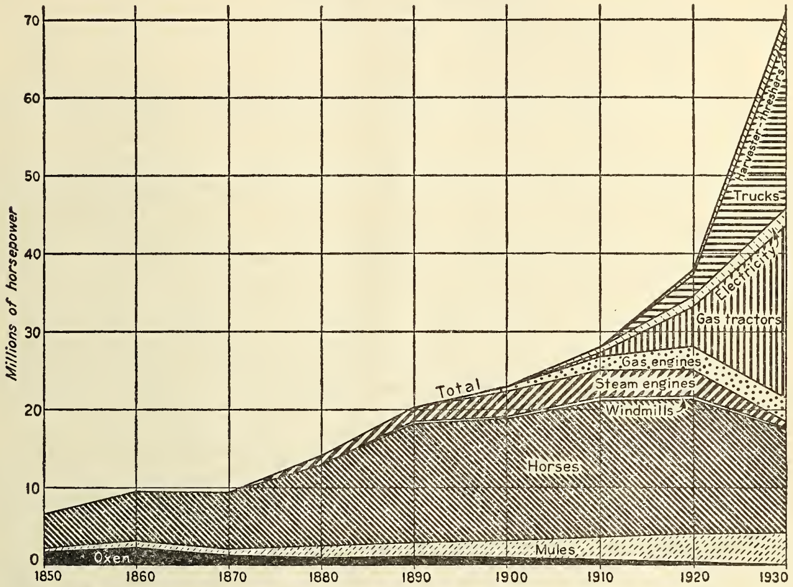

FIGURE 3.—Estimated total horsepower available on farms in the United States, 1850 to 1930. (Table 8)

KINDS OF POWER

Table 8 shows the kinds, and approximate amount of each kind, of power available on farms in the United States from 1850 to 1930. Horses and mules under two years of age have been omitted from the tabulation, as far as possible, because they are not considered as available power units. (See footnote 2, Table 8.) Changes which have occurred in the total amount of horsepower available on farms in the United States from 1850 to 1930 are shown graphically in Figure 3. As a general rule, the power of a work animal depends to a large extent upon its weight. Studies have indicated that a 1,200-pound horse usually is equivalent to one horsepower unit. The power of work animals has been computed on this basis. A study made in 1918 showed the average weight of work animals on farms by States to be 1,203 pounds for horses and 956 pounds for mules. It is thought that the average weight of horses has increased somewhat since that time, but sufficient data are not available to justify changes in the 1918 figures. It is doubtful whether the average weight of all work animals has increased, for horses have constituted a decreasing portion and mules an increasing portion of the total number of work animals.

TABLE 8.—*Estimated number of power units and of power available on farms in the United States, census years 1850 to 1930*

(In thousands—i. e., 000 omitted)

Power unit	1850		1860		1870		1880		1890	
	Number	Horsepower	Number	Horsepower	Number	Horsepower	Number	Horsepower	Number	Horsepower
Oxen [1]	1,701	1,701	2,255	2,255	1,319	1,319	994	994	1,117	1,117
Mules [2]	559	446	1,151	917	1,125	897	1,813	1,444	2,252	1,794
Horses [2]	4,337	4,347	6,249	6,265	7,145	7,163	10,357	10,383	15,266	15,304
Windmills [3]	------	------	------	------	------	------	200	66	400	132
Steam engines [4]	------	------	------	------	------	------	24	1,200	40	2,000
Total	------	6,494	------	9,437	------	9,379	------	14,087	------	20,347

Power unit	1900		1910		1920		1930	
	Number	Horsepower	Number	Horsepower	Number	Horsepower	Number	Horsepower
Oxen [1]	960	960	640	640	370	370	------	------
Mules [2]	2,753	2,194	3,787	3,017	4,652	3,706	5,273	4,146
Horses [2]	15,506	15,545	17,430	17,474	17,221	17,264	12,889	13,025
Windmills [3]	600	198	900	297	1,000	330	1,000	330
Steam engines [4]	70	3,500	72	3,600	70	3,500	25	1,000
Gas engines [5]	200	600	600	1,800	1,000	3,000	1,131	3,036
Electricity: [6]								
Individual plants	------	------	------	600	------	1,500	270	811
Central station	------	------	------				386	1,383
Gas tractors [7]	------	------	10	500	246	4,922	920	22,001
Trucks [8]	------	------	------	------	139	2,783	900	22,510
Harvester-threshers [9]	------	------	------	------	4	120	61	2,260
Total	------	22,997	------	27,928	------	37,495	------	70,502

[1] Figures for 1850 to 1890, from census reports; for 1900 to 1920, estimates based on Department Bul. 1348 *(11)*.

[2] For 1850, all ages except spring colts; for 1860, 1870, 1880, and 1890, probably a few but not all colts included; for 1900, 2 years old and over; for 1910, over 15½ months; for 1920, 2 years old and over; for 1930, may include some under 2 years. Bureau of the Census.

[3] Estimates based on Department Bul. 1348 (*11*); and Manufacture and Sale of Farm Equipment (*20*), published by the Bureau of the Census, and on information from other sources.

[4] For 1880 to 1920, estimates based on Department Bul. 1348. For 1930 estimates based on correspondence

[5] Estimates based on Manufacture and Sale of Farm Equipment (*20*), and correspondence.

[6] Based on Department Bul. 1348 (*11*). 1930 census and correspondence.

[7] For 1910 estimated; for 1920 and 1930 based on census reports and correspondence.

[8] Based on census reports.

[9] Estimates based on Manufacture and Sale of Farm Equipment (*20*), and correspondence.

The number of work oxen on farms began to decrease about 1860. At present comparatively few are used for farm work in the United States. The number of horses, and consequently the available power from this source, increased until about 1918, but has declined quite rapidly since that time. The number of mules continued to increase until about 1925, according to estimates of the Department of Agriculture. However, the 1930 census reports show more mules

2 years old and over on farms in 1930 than in 1920. This increase was probably due to the fact that mules are used chiefly in the Cotton Belt where the change from animal to mechanical power has not been as rapid as in some other parts of the country. Mules also seem to be replacing horses in some of the wheat and Corn Belt States.

Steam engines and windmills came into rather general use on farms in some parts of the United States soon after the Civil War. Steam tractors were used quite extensively for threshing grain and for plowing, but the total amount of power they provided was small in comparison with that of work animals. The windmill found its greatest use in semiarid regions for pumping water. The use of steam engines began to decline with the widespread use of gas engines, gas tractors, and electric motors. According to the annual production of windmills as shown by census reports, the amount of this kind of power seems to have changed very little in the past few decades.

The stationary gas engine came into use between 1890 and 1900, while electricity, the gas tractor, the motor truck, and the automobile began to be used for farm work between 1900 and 1910. The use of the stationary gas engine probably reached a peak between 1920 and 1930, but the use of electricity on the farm, the gas tractor, motor truck, and automobile continued to increase through 1930. Thus, in general, animal power on farms declined while mechanical power increased between 1918 and 1930. The gas tractor, motor truck, and automobile displaced horses and the electric motor competed with the gas engine and windmill. While the automobile is not considered a source of power for farm work, probably 50 per cent of its operating time is directly associated with farm business. The potential horsepower of automobiles on farms in the United States probably exceeded the total available horsepower from all other sources in 1930.

Use of electricity on farms in the United States has increased during the last few years in spite of the general depression in agriculture. However, there is probably no other source of energy suitable for so wide a variety of uses. In 1929 farmers in the United States paid approximately $46,484,000 to power companies for power and light. Much the larger part of this energy was for irrigation pumping. The early developments in agricultural machinery and equipment were confined chiefly to those for use in major farm operations, and for a long time labor-saving equipment for use in the farm home and about the farmstead received little attention. Electricity now plays an important part in making the home more comfortable and in eliminating much of the drudgery and monotony generally associated with farm life. A considerable amount of electrical energy may be consumed on the farm for household and farmstead uses. The flat iron, toaster, percolator, washing machine, incubator, water pump, refrigerator, milking machine, cream separator, or radio may require very little energy per unit of time, but such equipment is used more frequently and for more hours each year than is a motor for grinding feed, threshing grain, and doing similar work.

GEOGRAPHIC DISTRIBUTION OF POWER

Type of agriculture, topography, climate, and kind of crops produced, influence to a large extent the geographic distribution of power on farms in the United States. The available supply of labor is another factor which has brought about changes in power utilization in different parts of the country. With expansions in industry in some areas the available supply of farm labor decreased, resulting in an increase in the use of power and machinery on farms. The approximate available horsepower by States in 1930 is shown in Table 9. Figures 4 to 10 show the geographic distribution of each of the several types of power units on farms in the United States.

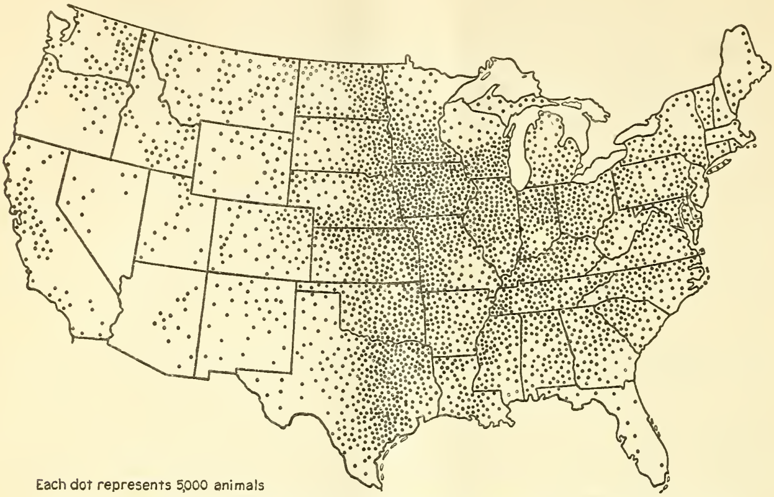

FIGURE 4.—Estimated distribution of work animals 2 years old and over on farms, 1930

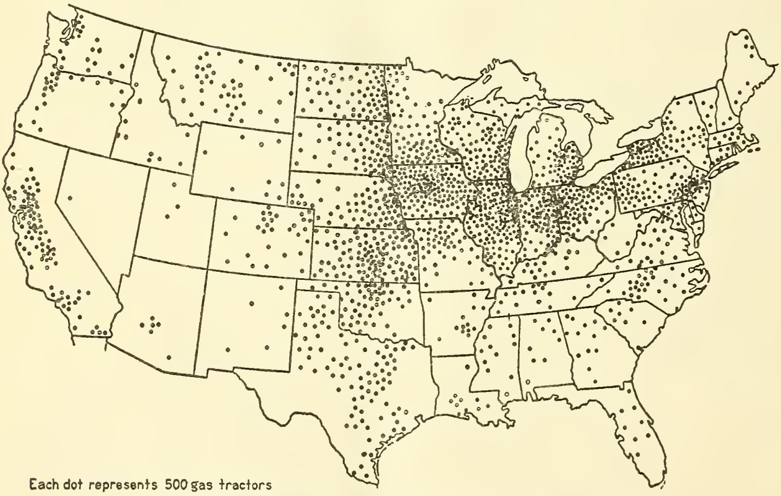

FIGURE 5.—Estimated distribution of gas tractors on farms, 1930

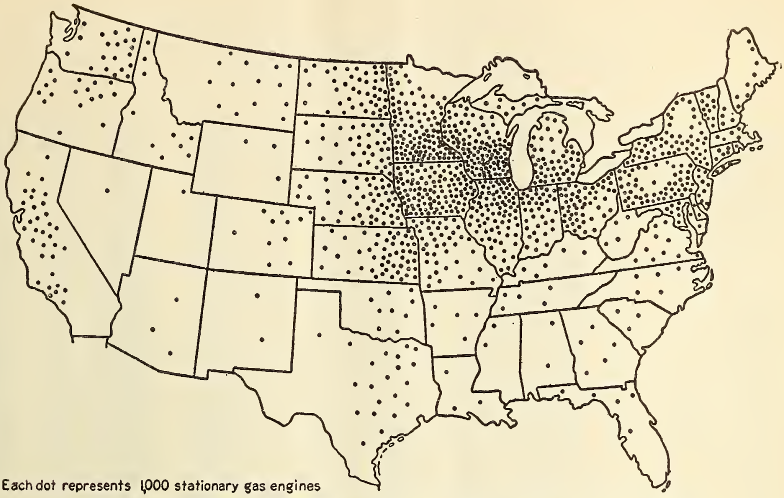

FIGURE 6.—Estimated distribution of stationary gas engines on farms, 1930

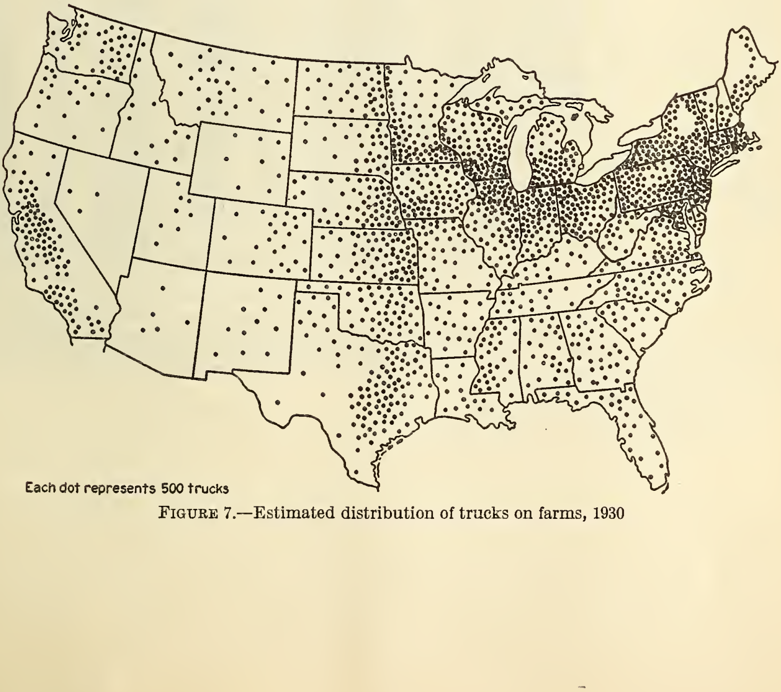

FIGURE 7.—Estimated distribution of trucks on farms, 1930

TABLE 9.—*Approximate available*

State	Horses and mules 2 years old and over			Gas tractors			Stationary gas engines		
	Number	Horsepower [2]		Number	Horsepower [3]		Number	Horsepower	
		Average	Total		Average	Total		Average	Total
Maine	61, 078	1. 10	67, 323	3, 410	20	68, 200	8, 342	2. 50	20, 855
New Hampshire	20, 093	1. 06	21, 235	1, 096	20	21, 920	3, 725	2. 50	9, 312
Vermont	52, 066	1. 00	51, 981	2, 426	20	48, 520	10, 962	2. 50	27, 405
Massachusetts	24, 809	1. 04	25, 898	3, 921	20	78, 420	5, 283	2. 50	13, 208
Rhode Island	3, 209	1. 07	3, 435	589	20	11, 780	707	2. 50	1, 768
Connecticut	21, 110	1. 01	21, 385	2, 667	20	53, 340	5, 462	2. 50	13, 655
New York	321, 577	. 98	315, 329	40, 369	23	928, 487	64, 723	2. 50	161, 808
New Jersey	42, 349	1. 00	42, 449	8, 088	20	161, 760	9, 036	2. 50	22, 590
Pennsylvania	356, 474	. 98	350, 636	33, 513	20	670, 260	57, 340	2. 50	143, 350
Ohio	509, 238	1. 08	549, 016	52, 974	22	1, 165, 428	52, 508	2. 50	131, 270
Indiana	506, 828	1. 02	515, 700	41, 979	21	881, 559	39, 380	2. 50	98, 450
Illinois	915, 205	1. 03	945, 039	69, 628	23	1, 601, 444	79, 300	2. 50	198, 250
Michigan	380, 156	1. 08	408, 895	34, 579	23	795, 317	55, 366	2. 50	138, 415
Wisconsin	539, 024	1. 08	582, 304	50, 173	20	1, 003, 460	108, 134	2. 50	270, 335
Minnesota	790, 336	1. 08	856, 187	48, 457	27	1, 308, 339	112, 376	2. 50	280, 940
Iowa	1, 079, 681	1. 08	1, 169, 240	66, 258	23	1, 523, 934	114, 977	2. 50	287, 442
Missouri	852, 403	. 91	775, 673	24, 999	20	499, 980	31, 718	2. 50	79, 295
North Dakota	592, 193	1. 07	635, 066	37, 605	30	1, 128, 150	44, 165	2. 50	110, 412
South Dakota	595, 209	1. 03	614, 104	33, 837	25	845, 925	34, 475	2. 50	86, 188
Nebraska	813, 833	1. 02	834, 270	40, 729	25	1, 018, 225	45, 902	2. 66	121, 975
Kansas	817, 627	. 99	810, 230	66, 275	28	1, 855, 700	38, 861	2. 55	99, 271
Delaware	26, 868	. 85	22, 911	1, 600	20	32, 000	1, 788	2. 50	4, 470
Maryland	119, 064	. 93	110, 390	7, 208	20	144, 160	9, 330	2. 50	23, 325
District of Columbia	173	. 94	162	17	20	340	10	2. 50	25
Virginia	287, 843	. 88	252, 163	9, 757	20	195, 140	10, 298	2. 50	25, 745
West Virginia	120, 871	. 95	115, 177	2, 792	20	55, 840	4, 314	2. 50	10, 785
North Carolina	379, 489	. 75	285, 432	11, 426	20	228, 520	4, 981	2. 50	12, 452
South Carolina	218, 978	. 77	169, 424	3, 462	22	76, 164	2, 677	2. 50	6, 692
Georgia	390, 202	. 81	314, 492	5, 870	22	129, 140	5, 000	2. 50	12, 500
Florida	61, 349	. 77	47, 541	5, 244	20	104, 880	4, 502	2. 50	11, 255
Kentucky	482, 991	. 82	394, 186	7, 322	22	161, 084	5, 326	2. 50	13, 315
Tennessee	480, 868	. 77	370, 750	6, 865	20	137, 300	4, 895	2. 50	12, 238
Alabama	394, 465	. 75	294, 205	4, 664	20	93, 280	2, 485	2. 50	6, 212
Mississippi	467, 049	. 72	337, 080	5, 542	20	110, 840	2, 186	2. 50	5, 465
Arkansas	492, 597	. 76	373, 170	5, 684	24	136, 416	4, 730	12. 56	59, 425
Louisiana	313, 275	. 77	241, 631	5, 016	20	100, 320	2, 639	19. 00	50, 130
Oklahoma	783, 731	. 86	675, 069	25, 962	28	726, 936	9, 363	2. 50	23, 408
Texas	1, 748, 129	. 80	1, 396, 987	37, 348	25	933, 700	18, 974	3. 79	71, 886
Montana	414, 181	1. 07	443, 514	19, 031	37	704, 147	13, 639	2. 54	34, 590
Idaho	200, 021	1. 05	210, 437	4, 691	25	117, 275	10, 024	2. 50	25, 060
Wyoming	159, 473	1. 07	170, 643	4, 110	24	98, 640	3, 424	2. 50	8, 560
Colorado	333, 279	1. 01	337, 638	13, 334	22	293, 348	11, 470	2. 70	30, 914
New Mexico	150, 796	. 84	127, 456	2, 497	21	52, 437	2, 018	7. 32	14, 775
Arizona	82, 678	. 94	77, 577	2, 558	20	51, 160	3, 095	3. 45	10, 692
Utah	87, 319	1. 05	91, 863	1, 426	22	31, 372	1, 236	2. 78	3, 436
Nevada	38, 811	. 99	38, 297	360	21	7, 560	1, 227	3. 13	3, 836
Washington	196, 762	1. 10	217, 053	8, 388	30	251, 640	18, 762	2. 56	48, 093
Oregon	179, 222	1. 08	193, 437	9, 838	25	245, 950	17, 189	2. 53	43, 485
California	256, 404	1. 04	267, 242	44, 437	25	1, 110, 925	32, 784	4. 48	146, 928
Total or average	18, 161, 386	0. 95	17, 171, 322	920, 021	23. 9	22, 000, 662	1, 131, 108	2. 68	3, 035, 891
Total, including estimate of 25,000 steam engines rated at 40 horsepower and 1,000,000 windmills									

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[1] Total number of horses and mules, gas tractors, stationary gas engines, trucks, and electric motors compiled from the 1930 census reports; total number of electric-light plants is difference between the number of dwelling houses on farms lighted by electricity and the number of farmers reporting the purchase of current from power companies, compiled from the 1930 census· combined harvester-threshers, estimated; and average horsepower per unit, estimated.

[2] Computed from estimated total weight of animals.

[3] Belt horsepower.

[4] Power refers to engine mounted on machine.

horsepower by States, April 1, 1930[1]

Trucks			Electric motors			Electric-light plants			Combined harvester-threshers			Total horsepower
Number	Horsepower		Number	Horsepower		Number	Horsepower		Number	Horsepower [4]		
	Average	Total		Average	Total		Average	Total		Average	Total	
10, 781	25	269, 525	5, 575	2. 00	11, 150	1, 982	3	5, 946	3	25	75	443, 074
4, 539	25	113, 475	2, 416	2. 00	4, 832	1, 146	3	3, 438	0	------	----------	174, 212
5, 035	25	125, 875	3, 645	2. 00	7, 290	1, 162	3	3, 486	0	------	----------	264, 557
9, 572	25	239, 300	6, 846	2. 00	13, 692	2, 216	3	6, 648	0	------	----------	377, 166
1, 701	25	42, 525	1, 181	2. 00	2, 362	239	3	717	0	------	----------	62, 587
6, 344	25	158, 600	4, 043	2. 00	8, 086	1, 388	3	4, 164	0	------	----------	259, 230
58, 974	25	1, 474, 350	24, 342	2. 00	48, 684	11, 669	3	35, 007	40	25	1, 000	2, 964, 665
14, 753	25	368, 825	5, 879	2. 00	11, 758	2, 473	3	7, 419	6	25	150	614, 951
47, 062	25	1, 176, 550	18, 461	2. 00	36, 922	12, 423	3	37, 269	50	25	1, 250	2, 416, 237
39, 210	25	980, 250	21, 278	2. 00	42, 556	19, 045	3	57, 135	170	30	5, 100	2, 930, 755
30, 037	25	750, 925	11, 030	2. 00	22, 060	11, 766	3	35, 298	425	25	10, 625	2, 314, 617
40, 371	25	1, 009, 275	15, 557	2. 00	31, 114	15, 914	3	47, 742	700	30	21, 000	3, 853, 864
36, 768	25	919, 200	14, 892	2. 00	29, 784	10, 552	3	31, 656	55	25	1, 375	2, 324, 642
51, 786	25	1, 294, 650	33, 795	2. 00	67, 590	16, 332	3	48, 996	5	25	125	3, 267, 460
36, 557	25	913, 925	19, 926	2. 00	39, 852	10, 929	3	32, 787	150	30	4, 500	3, 436, 530
32, 669	25	816, 725	27, 801	2. 00	55, 602	20, 893	3	62, 679	350	25	8, 750	3, 924, 372
20, 132	25	503, 300	4, 949	2. 00	9, 898	7, 737	3	23, 211	140	25	3, 500	1, 894, 857
16, 990	25	424, 750	4, 878	2. 00	9, 756	4, 471	3	13, 413	3, 300	30	99, 000	2, 420, 547
14, 816	25	370, 400	4, 686	2. 00	9, 372	6, 536	3	19, 608	1, 400	40	56, 000	2, 001, 597
26, 045	25	651, 125	8, 303	2. 19	18, 190	13, 895	3	41, 685	3, 300	40	132, 000	2, 817, 470
33, 648	25	841, 200	7, 463	2. 40	17, 935	10, 415	3	31, 245	24, 000	40	960, 000	4, 615, 581
2, 996	25	74, 900	513	2. 00	1, 026	534	3	1, 602	10	25	250	137, 159
11, 284	25	282, 100	3, 669	2. 00	7, 338	2, 919	3	8, 757	45	25	1, 125	577, 195
81	25	2, 025	8	2. 00	16	13	3	39	0	------	----------	2, 607
19, 459	25	486, 475	3, 632	2. 00	7, 264	5, 279	3	15, 837	35	25	875	983, 499
7, 432	25	185, 800	1, 269	2. 00	2, 538	2, 486	3	7, 458	1	25	25	377, 623
18, 558	25	463, 950	2, 320	2. 00	4, 640	6, 232	3	18, 696	25	25	625	1, 014, 315
6, 966	25	174, 150	945	2. 00	1, 890	3, 028	3	9, 084	30	25	750	438, 154
15, 967	25	399, 175	1, 246	2. 00	2, 492	3, 908	3	11, 724	24	30	720	870, 243
12, 203	25	305, 075	2, 481	2. 00	4, 962	2, 358	3	7, 074	0	------	----------	480, 787
7, 188	25	179, 700	1, 484	2. 00	2, 968	4, 828	3	14, 484	15	25	375	766, 112
9, 039	25	225, 975	1, 603	2. 00	3, 206	3, 290	3	9, 870	8	25	200	759, 539
12, 838	25	320, 950	972	2. 00	1, 944	2, 620	3	7, 860	6	25	150	724, 601
16, 503	25	412, 575	632	2. 00	1, 264	2, 438	3	7, 314	175	25	4, 375	878, 913
11, 000	25	275, 000	1, 460	12. 80	18, 692	2, 432	3	7, 296	5	25	125	870, 124
9, 281	25	232, 025	633	20. 26	12, 822	2, 225	3	6, 675	5	25	125	643, 728
23, 930	25	598, 250	2, 418	2. 00	4, 836	4, 149	3	12, 447	7, 000	40	280, 000	2, 320, 946
52, 580	25	1, 314, 500	5, 351	4, 89	26, 179	12, 900	3	38, 700	5, 600	30	168, 000	3, 949, 952
14, 615	25	365, 375	1, 708	3. 18	5, 434	1, 564	3	4, 692	5, 900	40	236, 000	1, 793, 752
6, 281	25	157, 025	6, 713	2. 32	15, 552	2, 078	3	6, 234	1, 160	40	46, 400	577, 983
4, 108	25	102, 700	481	2. 00	962	691	3	2, 073	200	30	6, 000	389, 578
16, 918	25	422, 950	3, 299	2. 94	9, 703	2, 845	3	8, 535	1, 600	30	48, 000	1, 151, 088
5, 328	25	133, 200	580	7. 21	4, 179	589	3	1, 767	430	30	12, 900	346, 714
3, 062	25	76, 550	2, 054	11. 91	24, 470	601	3	1, 803	70	25	1, 750	244, 002
4, 189	25	104, 725	1, 756	4. 03	7, 082	1, 316	3	3, 948	300	30	9, 000	251, 426
1, 241	25	31, 025	960	3. 31	3, 182	329	3	987	15	30	450	85, 337
18, 836	25	470, 900	15, 788	2. 75	43, 444	4, 986	3	14, 958	950	30	28, 500	1, 074, 588
9, 741	25	243, 525	9, 010	2. 62	23, 598	3, 406	3	10, 218	1, 500	30	45, 000	805, 213
40, 971	25	1, 024, 275	66, 260	9. 70	643, 048	7, 076	3	21, 228	1, 600	40	64, 000	3, 277, 646
900, 385	25	22, 509, 625	386, 191	3. 58	1, 383, 216	270, 303	3	810, 909	60, 803	37. 2	2, 260, 170	69, 171, 795

rated at 0.33 horsepower not shown by States--70, 501, 795

The type of agriculture seems to have a greater effect on the amount of horsepower per agricultural worker than does any other one factor. This is indicated in Figure 11, which shows more available power per agricultural worker in the wheat-producing areas of the Great Plains States than in any other region. Montana leads with approximately 22.5 available horsepower per agricultural worker, and is followed by Kansas with 20.1, North Dakota with 18, South Dakota with 15.3, Nebraska with 14.3, and Wyoming with 12.6. When considered by geographic areas the West North Central group of States lead, followed in order by the Mountain, Middle Atlantic, East North Central, Pacific, New England, West South Central, South Atlantic, and East South Central.

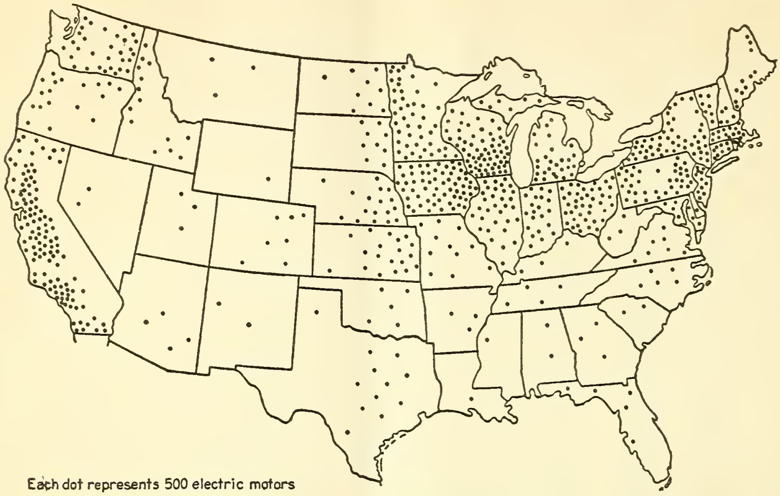

FIGURE 8.—Estimated distribution of electric motors for farm work, 1930

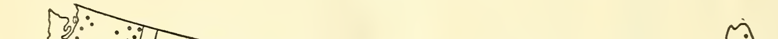

FIGURE 9.—Estimated distribution of electric-light plants on farms, 1930

The average gross farm income for 1925 to 1929, total, per farm and per worker, is shown in Table 10. Figure 12, based on Tables 6, 9, and 10, shows the general correspondence between the power available, the investment in mechanical equipment, and the average gross income derived from crops, livestock, and livestock products, per agricultural worker. The States having the most available power usually led in value of agricultural products per worker, as might naturally be expected, though there were a number of exceptions among which were the three States showing the largest incomes.

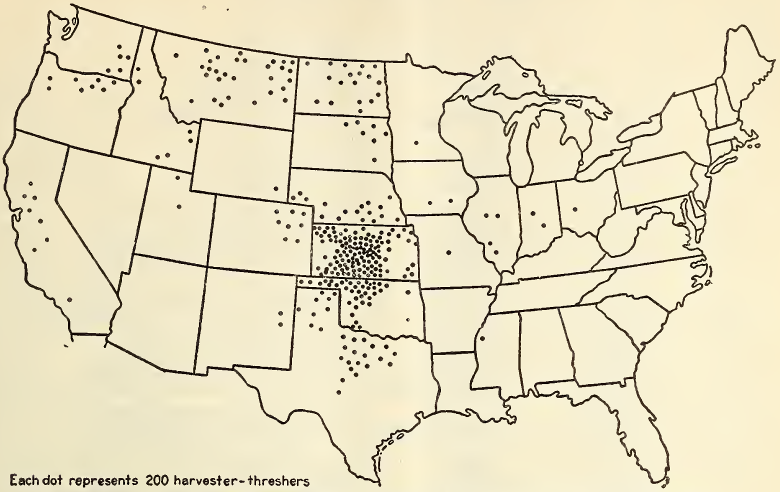

FIGURE 10.—Estimated distribution of combined harvester-threshers on farms, 1930

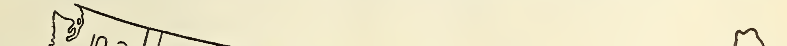

FIGURE 11.—Average horsepower available per agricultural worker by States, 1930

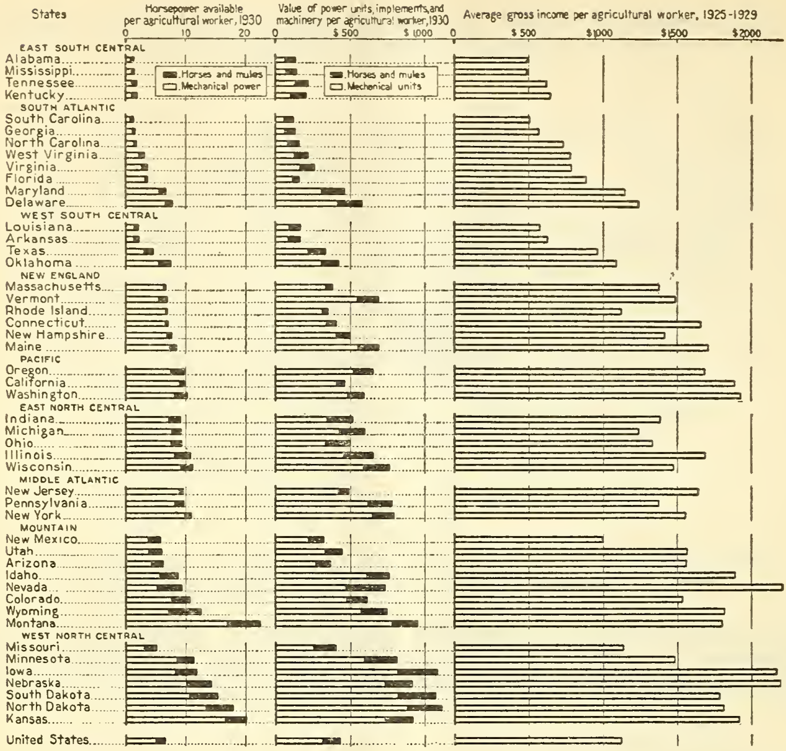

FIGURE 12.—Power available and value of power units and machinery, 1930, and average gross income, 1925 to 1929, per agricultural worker

TABLE 10.—*Average gross income of farms in the United States, 1925–1929*

State	Farms [1]	Agricultural workers [1]	Gross income [2]		
			Total	Per farm	Per worker
	Number	*Number*	*Dollars*	*Dollars*	*Dollars*
Maine	39, 006	51, 519	87, 941, 000	2, 255	1, 707
New Hampshire	14, 906	22, 091	31, 349, 000	2, 103	1, 419
Vermont	24, 898	38, 141	56, 856, 000	2. 284	1, 491
Massachusetts	25, 598	56, 015	77, 132, 000	3, 013	1, 377
Rhode Island	3, 322	8, 873	9, 993, 000	3, 008	1, 126
Connecticut	17, 195	36, 687	60, 996. 000	3, 547	1, 663
New York	159, 806	267, 979	417, 902, 000	2, 615	1, 559
New Jersey	25, 378	64, 471	105, 719, 000	4, 166	1, 640
Pennsylvania	172, 419	251, 443	345, 498, 000	2, 004	1, 374
Ohio	219, 296	312, 218	415, 847, 000	1, 896	1, 332
Indiana	181, 570	250, 150	346, 572, 000	1, 909	1, 385
Illinois	214, 497	352, 524	595, 953, 000	2, 778	1, 691
Michigan	169, 372	247, 963	306, 593, 000	1, 810	1, 236
Wisconsin	181, 767	290, 134	428, 469, 000	2, 357	1, 477
Minnesota	185, 255	303, 822	449, 691, 000	2, 427	1, 480
Iowa	214, 928	331, 152	720, 491, 000	3, 352	2, 176
Missouri	255, 940	371, 251	422, 744, 000	1, 652	1, 139
North Dakota	77, 975	134, 451	243, 722, 000	3, 126	1, 813
South Dakota	83, 157	130, 786	233, 404, 000	2, 807	1, 785
Nebraska	129, 458	197, 342	434, 894, 000	3, 359	2, 204
Kansas	166, 042	229, 544	441, 044, 000	2, 656	1, 921

[1] Census report, 1930.

[2] Includes crops, livestock, and livestock products and relates to cash income plus the value of the products consumed in the farm household on the farm where the commodities were produced—Bureau of Agricultural Economics.

TABLE 10.—*Average gross income of farms in the United States, 1925–1929*—Con.

State	Farms	Agricultural workers	Gross income		
			Total	Per farm	Per worker
	Number	*Number*	*Dollars*	*Dollars*	*Dollars*
Delaware	9,707	17,341	21,502,000	2,215	1,240
Maryland	43,203	84,226	96,679,000	2,238	1,148
District of Columbia	104	1,099			
Virginia	170,610	270,836	213,879,000	1,254	790
West Virginia	82,641	118,162	92,243,000	1,116	781
North Carolina	279,708	499,923	367,852,000	1,315	736
South Carolina	157,931	344,641	174,365,000	1,104	506
Georgia	255,598	497,716	283,312,000	1,108	569
Florida	58,966	133,648	118,725,000	2,013	888
Kentucky	246,499	358,575	231,994,000	941	647
Tennessee	245,657	376,623	234,458,000	954	623
Alabama	257,395	492,818	242,795,000	943	493
Mississippi	312,663	557,402	277,806,000	889	498
Arkansas	242,334	384,612	242,427,000	1,000	630
Louisiana	161,445	297,239	171,488,000	1,062	577
Oklahoma	203,866	306,140	333,886,000	1,638	1,091
Texas	495,489	842.001	812,206,000	1,639	965
Montana	47,495	79,678	143,589,000	3,023	1,802
Idaho	41,674	65,561	124,292,000	2,982	1,896
Wyoming	16,011	30,827	55,895,000	3,491	1,813
Colorado	59,956	106,234	163,037,000	2,719	1,535
New Mexico	31,404	58,971	58,919,000	1,876	999
Arizona	14,173	38,697	60,509,000	4,269	1,564
Utah	27,159	41,283	64,843,000	2,388	1,571
Nevada	3,442	8,948	19,791,000	5,750	2,212
Washington	70,904	104,294	201,321,000	2,839	1,930
Oregon	55,153	82,031	138,385,000	2,509	1,687
California	135,676	334,241	632,079,000	4,659	1,891
Total or average	6,288,648	10,482,323	[3] 11,814,662,000	1,879	1,127

[3] Includes $3,575,000 from sugar beets not included in State totals.

AMOUNT OF POWER DEVELOPED

Table 11 summarizes the amount of power available, by types, on farms in the United States in 1930, and gives an estimate of the horsepower-hours developed annually. Of the total of nearly 17,000,000,000 horsepower-hours developed annually, animals furnish approximately 50 per cent.

TABLE 11.—*Estimated power available and power developed, on farms in the United States, 1930*

Kind of power	Power units				Power developed annually		
	Number	Average size	Total rating		Average[1] per rated horsepower	Total	
	Thousands	*Horsepower*	*1,000 horsepower*	*Per cent*	*Horsepower-hours*	*1,000 horsepower-hours*	*Per cent*
Work animals:							
Horses	12,889	1.01	13,025	18.4	500	6,512,500	38.7
Mules	5,273	.79	4,146	5.9	500	2,073,000	12.3
Windmills	1,000	.33	330	.5	400	132,000	.8
Steam engines	25	40.00	1,000	1.4	300	300,000	1.8
Gas engines:							
Small	1,118	2.50	2,796	4.0	200	559,200	3.3
Large [2]	13	18.82	240	.3	1,000	240,000	1.4
Individual electric plants	270	[3] 3.00	811	1.2	[3] 160	129,760	.8
Central station:							
Small motors	343	2.00	685	1.0	200	137,000	.8
Large motors [2]	43	16.05	698	1.0	1,000	698,000	4.2
Gas tractors:							
Drawbar	920	11.95	[4] 11,000	[4] 15.6	230	2,530,000	15.0
Belt	920	23.90	22,001	31.2	70	1,540,070	9.2
Trucks	900	25.00	22,510	31.9	80	1,800,800	10.7
Harvester-threshers	61	37.20	2,260	3.2	75	169,500	1.0
Total			70,502	100.0		16,821,830	100.0

[1] Estimated equivalent hours operated at rated capacity.
[2] Pumping water for irrigation; based on reports of the Bureau of the Census.
[3] Represents input, not output.
[4] Duplicated in belt-power rating.

Probably the most significant change which has occurred recently in the annual use of individual power units has been in the use of the general-purpose tractor. This type of tractor can be used for a greater variety of farm operations than can other types and hence can be used more hours per season.

With the widespread use of mechanical-power units on farms there has also been a change in the type of work performed by horses. With a tractor available for heavy-drawbar work and a truck for hauling, the use of work animals on some farms is largely confined to light-drawbar work. In some cases it has been possible to increase the number of hours of annual use per work animal by decreasing the number of such units per farm, and by the proper coordination of animal and mechanical power units.

CHOICE OF POWER

Work animals and tractors are at present the chief sources of power for field work. The tractor was at first considered a supplementary source of farm power, in that it could be used to advantage only for heavy work such as plowing and disking, and for belt work. In portions of the wheat-producing areas of the Great Plains and the Northwest, the tractor proved to be practicable for all field work. This was not the case, however, where row crops such as cotton, corn, and potatoes are of major importance. In such areas horses or mules are the principal source of power on farms. The general-purpose tractor has made it possible, however, to prepare the soil, plant, cultivate, and in some cases to harvest the crop without using animals. Where row crops predominate, the general-purpose tractor can be used not only for a larger number of farm operations than other types of tractors, but also for more hours per season, thus reducing the overhead expense per horsepower-hour developed.

There seems to be no definite rule for selecting the best type of power for any particular farm use. In some cases the choice might depend on the original cost, while in others the operating cost, adaptability, or ease of operation might be the determining factor. For the principal field operations, however, economy and timeliness in getting the work done are usually of major importance. A choice of power type should be made only after careful consideration of the advantages and disadvantages of the different types that are suitable for the job. The following are some of the chief advantages and disadvantages of the different kinds of power used on farms:

ANIMAL

Advantages	Disadvantages
Great reserve power for emergencies and temporary overload. Feed can be produced on the farm. Power unit can be produced on farm. Flexible in size of working units, within limits. Adapted to practically all draft work. Fairly good traction in wet or loose soil. Assists in maintaining soil fertility.	Requires frequent resting when working under heavy load. Can not work most efficiently in hot weather. Working speed and number of hours per day limited. Requires large amount of time for feeding and harnessing when in use, and some care when not in use. Not suitable for belt work.

GAS TRACTOR

Advantages	Disadvantages
Requires no fuel or attention when not in use.	Not flexible in size of working unit, and operates most efficiently only near rated capacity.
Adapted to draft, belt, and power-take-off work.	Requires mechanical skill for successful operation without some expert service.
Can work continuously at heavy load.	Requires cash expenditure for fuel and lubricants.
Has considerable range of working speed.	Has limited overload capacity.
Is not affected by hot weather.	
Requires small storage space.	

STATIONARY GAS ENGINE

Has practically the same advantages as the gas tractor. Its chief advantage over the electric motor is its portability.	Its chief disadvantage in comparison with the electric motor are: Difficulty in starting. Noise and exhaust fumes. More care required in operating and adjusting.

ELECTRIC MOTOR

Convenience in operation.	Current is expensive unless considerable amount is used annually and unless motor is located near central-station power lines.
Requires little care.	Not generally suitable for draft work.
Adapted to practically all kinds of belt work.	
Suitable for direct connection with some machines.	
Adaptable to automatic control.	

MOTOR TRUCK

Great range of speed.	Poor traction on wet or loose soil.
Saves time on good roads.	Use limited largely to transportation.
Requires little attention when not in use.	Not always economical on short hauls.

COST OF POWER

The cost of farm power consists of operating expenses and the fixed or overhead cost. Operating expenses involve such items as feed, fuel, lubricants, and expert service, while the fixed cost is made up of such items as interest on the investment, depreciation, housing, taxes, and insurance. Aside from the effect which use may have on the useful life of a power unit, the annual fixed cost remains the same regardless of whether the horse or engine is used 100 or 1,000 hours annually. There seems to be little direct relation between the hours of annual use and the useful life of a power unit. The cost of repairs will, of course, be greater for a mechanical-power unit which is used a large number of hours annually than a similar unit used but little, while the cost per hour of use may be practically the same. However, a mechanical-power unit which is used but little may be damaged more by rust than by use.

Table 12 shows the approximate annual fixed cost and the operating cost of a general-purpose tractor in 1930 based on 500 hours of use annually. The general-purpose tractor is more comparable with work animals than any other type, with respect to performing drawbar work. The cost of operating a general-purpose tractor is, however, practically the same as that of operating any other gas tractor of the same rated horsepower. With fuel and lubricants at given prices, the operating cost per drawbar horsepower-hour developed by any tractor will depend in part on the size and type of tractor, its mechanical condition, the load, the traction, and the skill of the operator. However, the items of expense shown in Table 12 are thought to be representative for a general-purpose tractor under ordinary farm conditions and at the price levels of 1930.

TABLE 12.—*Approximate cost of power from a 10–20 general-purpose tractor, 1930* [1]

Item of expense	Cost per year		
	Fixed	Operating	Total
	Dollars	*Dollars*	*Dollars*
Interest on average investment at 6 per cent [2]	27		27
Depreciation at 12 per cent [2]	108		108
Repairs and expert service		30	30
Fuel, 1.8 gallons per hour, at 14 cents a gallon for 500 hours		126	126
Oil, 0.1 gallon per hour, at 70 cents a gallon for 500 hours		35	35
Chore labor, 40 hours, at 25 cents an hour		10	10
Total	135	201	336
Cost per hour based on 500 hours of use	.270	.402	.672
Cost per rated drawbar horsepower-hour	.027	.0402	.0672

[1] Based on survey of power on farms made by U. S. Department of Agriculture and data given in the following publications: Ind. Agr. Exp. Sta. Bul. 332 (*12*); Iowa Agr. Exp. Sta. Bul. 260 (*4*); Iowa Agr. Exp. Sta. Bul. 264 (*9*); Nebr. Agr. Exp. Sta. Bul. 242 (*14*); Tex. Agr. Exp. Sta. Bul. 362 (*5*); N. Y. Cornell Agr. Exp. Sta. Bul. 506 (*6*).

[2] Based on $900 first cost and uniform annual depreciation.

A farm tractor, when developing its rated horsepower, will usually consume about 1.1 pounds of gasoline per horsepower-hour developed at drawbar work. On this basis, a 10–20 tractor will consume about 18 gallons of gasoline per 10 hours of drawbar work. Oil consumption will vary considerably with the mechanical condition of the tractor, grade of oil, and kind of fuel used, but a general-purpose tractor rated at about 10–20 horsepower will usually use about 1 gallon of oil per day.

Table 13 shows the approximate cost of animal power based on 700 hours of annual use in 1930. The actual cost of animal power depends of course on a number of factors, but the figures in Table 13 are thought to be representative for comparison with the cost of mechanical power in 1930. On farms where tractors are used for the heavy work, the feed required for horses may be reduced, thus reducing the unit cost of animal power, and on farms where good pasture is available the cost of animal power may be lower than is indicated by Table 13.

Since 1930 there has been a decrease in the cost of both animal and mechanical power on farms. The greater part of this decrease has resulted from the reduction in cost of feed and man labor, although the costs of fuel and lubricants also have been reduced. Tables 14 and 15 show the items of expense which are thought to be representative for comparing the costs of mechanical and animal power during the period of July 1, 1931, to June 30, 1932.

TABLE 13.—*Approximate cost of animal power, 1930* [1]

Item of expense	Cost per year		
	Fixed	Operating	Total
	Dollars	*Dollars*	*Dollars*
Interest on average investment at 6 per cent [2]	3.15		3.15
Depreciation at 8 per cent [2]	8.40		8.40
Feed and bedding	40.00	40.00	80.00
Man labor, 60 hours at 25 cents per hour	7.50	7.50	15.00
Veterinary service and shoeing	1.00	1.00	2.00
Total	60.05	48.50	108.55
Credit for colts	2.00		2.00
Credit for manure	10.00		10.00
Net cost	48.05	48.50	96.55
Cost per hour based on 700 hours of use	.0686	.0693	.1379

[1] Based on survey of power on farms made by U. S. Department of Agriculture and data given in the following publications: Iowa Agr. Expt. Sta. Bul. 261 (*8*); Iowa Agr. Expt. Sta. Bul. 264 (*9*); Ind. Agr. Expt. Sta. Bul. 332 (*12*); Ill. Agr. Expt. Sta. Bul. 329 (*1*), based on studies of farms in east-central Illinois; Tex. Agr. Expt. Sta. Bul. 362 (*5*); U. S. Dept. Agr. Statis. Bul. 5 (*19*); Farmers' Bul. 1298 (*3*).

[2] Based on first cost of $75 for horse and $30 for harness, and uniform annual depreciation.

TABLE 14.—*Approximate cost of power from a 10–20 general-purpose tractor, 1931–32* [1]

Item of expense	Cost per year		
	Fixed	Operating	Total
	Dollars	*Dollars*	*Dollars*
Interest on average investment at 6 per cent [2]	27.00		27.00
Depreciation at 12 per cent [2]	108.00		108.00
Repairs and expert service		25.00	25.00
Fuel, 1.8 gallons per hour at 10 cents, for 500 hours		90.00	90.00
Oil, 0.1 gallon per hour at 60 cents for 500 hours		30.00	30.00
Chore labor, 40 hours at 12 cents per hour		4.80	4.80
Total	135.00	149.80	284.80
Cost per hour based on 500 hours of use	.270	.300	.570
Cost per rated drawbar horsepower-hour	.0270	.0300	.0570

[1] Calculated at average prices for period July 1, 1931, to June 30, 1932.

[2] Based on $900 first cost.

TABLE 15.—*Approximate cost of animal power, 1931–32* [1]

Item of expense	Cost per year		
	Fixed	Operating	Total
	Dollars	*Dollars*	*Dollars*
Interest on average investment at 6 per cent [2]	3.15		3.15
Depreciation at 8 per cent [2]	8.40		8.40
Feed and bedding	22.50	22.50	45.00
Man labor—60 hours, at 12 cents per hour	3.60	3.60	7.20
Veterinary service and shoeing	1.00	1.00	2.00
Total	38.65	27.10	65.75
Credit for colts	2.00		2.00
Credit for manure	10.00		10.00
Net cost	26.65	27.10	53.75
Cost per hour based on 700 hours of use	.0381	.0387	.0768

[1] Calculated at average prices for period July 1, 1931, to June 30, 1932.

[2] Based on first cost of $75 for horse and $30 for harness.

Figures 13 and 14 show the relative costs of power developed by a horse and by a general-purpose tractor, as affected by hours of use per year in 1930 and for the period July 1, 1931, to June 30, 1932. These graphs show tractor power to be cheaper than animal power when each type is worked effectively at the rated capacity of the unit. It does not mean that one tractor is less expensive to maintain and operate than one horse, but that tractor power is the cheaper when enough power is required to justify the use of so large a power unit. Figure 15 shows the costs of drawbar work by 2, 4, and 6 horse teams and by a 10–20 general-purpose tractor at 1930 prices, and Figure 16 shows the same at prices prevailing during the period July 1, 1931, to June 30, 1932. Figures 15 and 16 indicate that if fewer than 5 horses could have been used to perform the work of a general-purpose tractor in 1930 or fewer than 7 horses during the period July 1, 1931, to June 30, 1932, they would furnish the power at lower cost than the tractor, assuming the same labor and equipment cost for both types of power. When a tractor is used, however, it may be possible to decrease the man labor employed, increase the acreage cultivated, or make more time available for other work on the farm.

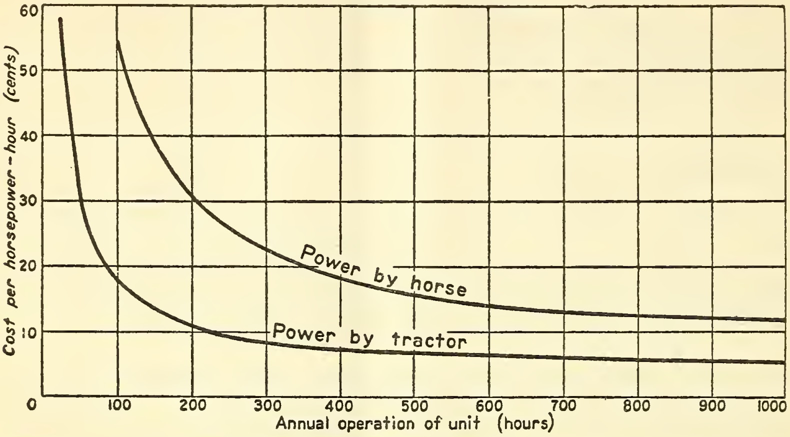

FIGURE 13.—Cost per rated drawbar horsepower hour developed by horse and by general-purpose tractor, 1930

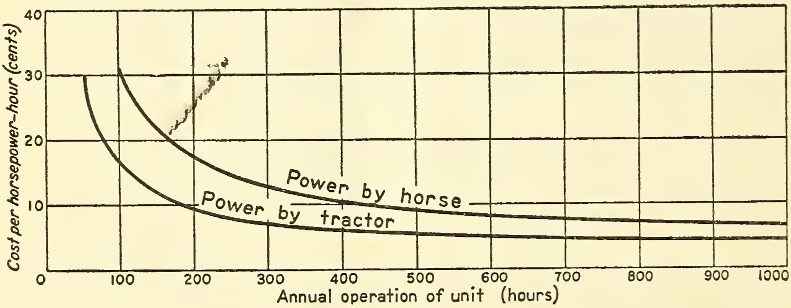

FIGURE 14.—Cost per rated drawbar horsepower hour developed by horse and by general-purpose tractor, July 1, 1931, to June 30, 1932

When a choice is to be made between horses and a tractor, the following questions in addition to those involving the cost of power should be considered.

(1) How many other power units now available could be disposed of?
(2) How much hired labor could be dispensed with?
(3) Is timely performance or speed in getting the work done of great importance?

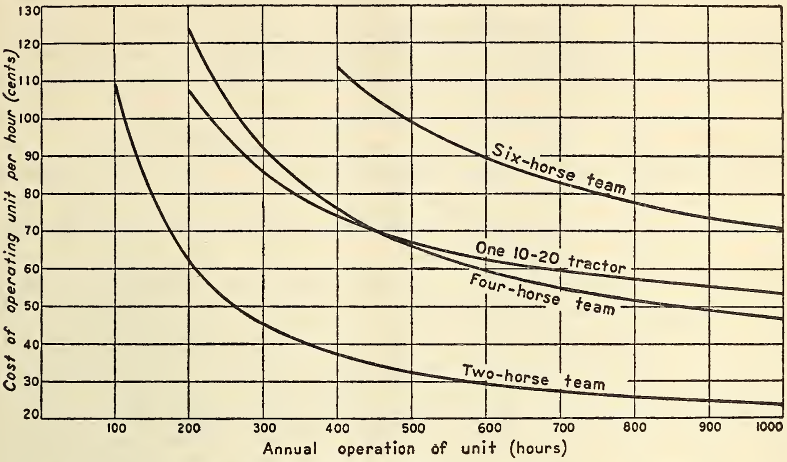

FIGURE 15.—Cost of power for drawbar work as developed by a 10–20 general-purpose tractor and by teams of 2, 4, and 6 horses, at 1930 prices

(4) If a tractor is used, would more time be available for producing livestock, poultry, fruit, and vegetables, or for making general improvements on the farm?
(5) How much new equipment would be necessary?

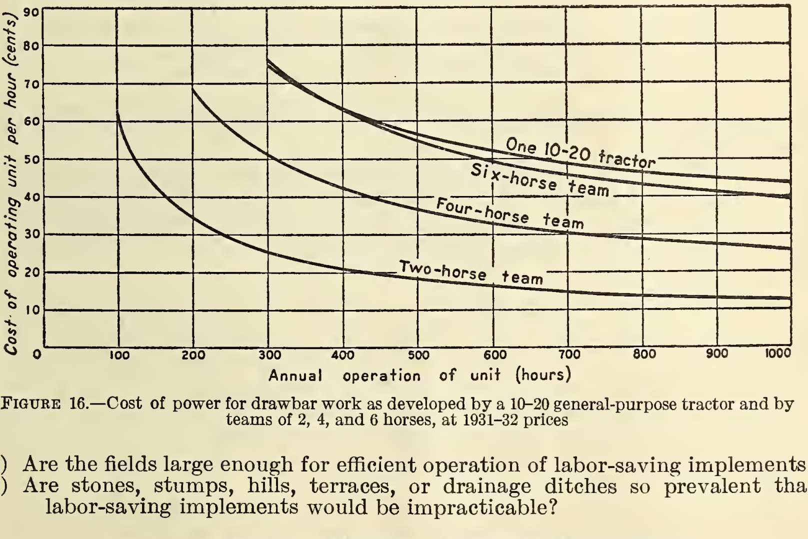

FIGURE 16.—Cost of power for drawbar work as developed by a 10–20 general-purpose tractor and by teams of 2, 4, and 6 horses, at 1931–32 prices

(6) Are the fields large enough for efficient operation of labor-saving implements?
(7) Are stones, stumps, hills, terraces, or drainage ditches so prevalent that labor-saving implements would be impracticable?

MAJOR DEVELOPMENTS IN FARM TRACTORS

Reports of the Nebraska tractor tests show that manufacturers have accomplished a great deal during the past 10 years in reducing weight per drawbar horsepower developed, in fuel economy, and in mechanical efficiency of farm tractors. Average results of such tests are illustrated in Figure 17. In 1920, the year in which those tests were begun, the average weight per maximum drawbar horsepower developed was about 346 pounds. In 1930 the average weight of the tractors tested was about 228 pounds per drawbar horsepower.[2] During the same period the average horsepower-hours per gallon of fuel used, based on the rated load brake test, increased from approximately 7.5 to 9. The ratio between the maximum drawbar and the maximum belt horsepower developed increased from approximately 66 per cent in 1920 to 76 per cent in 1930. The fluctuations shown in Figure 17 are doubtless due in part to differences in the types of tractors tested.

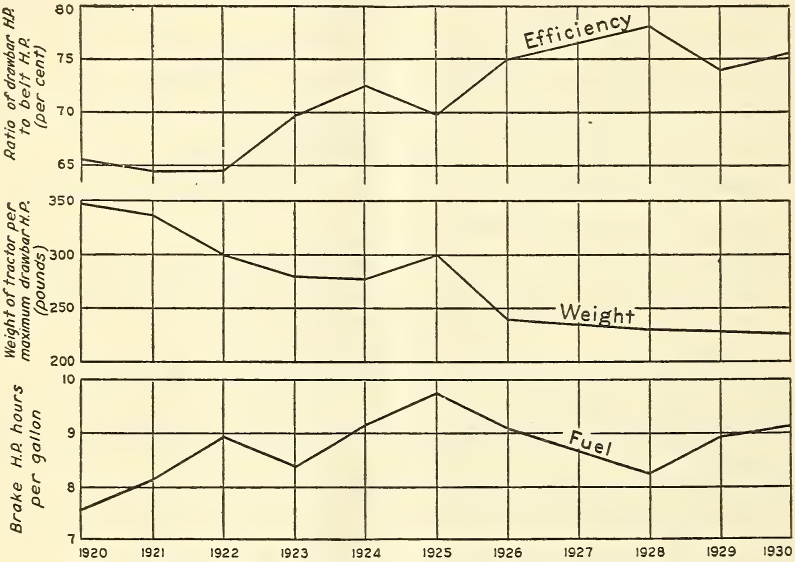

FIGURE 17.—Results of Nebraska tractor tests from 1920 to 1930. *(14)*

Information from various sources indicates that the recent models are, as a general rule, more durable, more reliable, and better adapted to a wide variety of uses than those manufactured earlier. The introduction of the power take-off also has increased the usefulness of the farm tractor.

Improvements in the design of garden tractors have made this power unit more reliable and applicable to a greater variety of uses. Studies made by several State institutions indicate that the garden tractor is being used extensively in truck farming. Some persons engaged in occupations other than farming, but who produce vegetables primarily for home consumption, frequently find it more desirable to own a garden tractor than to keep or hire a horse for such work.

Tests made after 1920 indicate the new designs offered for sale each year rather than the performance or characteristics of all tractors in use.

FARM IMPLEMENTS

Numerous and extensive developments in the production and use of farm implements have taken place and are continuing at a rate which tends to change the picture. Because of this fact and because a wide variety of implements are used on farms, space in this publication will permit only a brief summary of some of the major developments.

Mechanical equipment in the human-power age actually comprised nothing more than hand tools. During the animal-power period, however, considerable progress was made in developing practically all classes of agricultural implements. Animal power is not well suited for belt work, hence the development of belt-driven agricultural machinery was more closely associated with the development of the steam engine, stationary gas engine, tractor, and electric motor.

The fundamental principles involved in many of our present-day farm implements are the same as those employed many years ago, but great advance has been made in the character of the materials used and in the construction and adaptability of such equipment. The present-day implements are, as a rule, made of better material; they are stronger, more durable, lighter in weight per unit of capacity, and will do better work than their predecessors. With improvements in design and corresponding decrease in weight, it has been possible in some cases to materially reduce the power requirements for a given operation.

The most outstanding recent advance in design of plows is probably the development of the wheatland or vertical disk plow, which is a combination disk plow and disk harrow. The disk blades, about 20 inches in diameter, are spaced approximately 6 to 10 inches apart and are placed to throw all the dirt in one direction. The soil is not turned over, as with the moldboard plow, but is moved to one side with a stirring action. Trash and stubble are mixed with the soil, which gives the field a ragged appearance, but the protruding stubble and trash tend to prevent blowing of the soil and to cause snow to lodge, thus conserving moisture. The vertical disk plow has made possible a reduction in power and labor requirements for seed-bed preparation in the Great Plains States. It seems probable that this plow will be useful in row-crop regions.

Progress has been made also in developing auxiliary equipment or attachments for tractor-drawn moldboard plows to improve their performance. With such equipment it may be possible under some conditions to prepare the seed bed with less power and labor than was formerly required.

The rotary hoe, stiff-tooth cultivator, and rod weeder, no one of which is in reality a new machine, have come into rather general use in some areas during the past few years. The rotary hoe has found its greatest use in the Corn Belt, and the stiff-tooth cultivator and the rod weeder in summer-fallow areas of the Great Plains States and the Northwest. Besides the introduction of these implements, a great deal has been accomplished in developing cultivator attachments for the general-purpose tractor. The power lift for raising the cultivator gangs affords ease and speed in turning.

The salient features of modern grain drills and planters took definite form some 50 or 60 years ago, but such equipment has been greatly improved during recent years. Such improvements have largely been associated with the adaptation of these implements for use with farm tractors.

The development of fertilizer distributors is closely associated with that of planters and drills. Recent improvements in this line of equipment involve refinements in mechanical details and the introduction of fertilizer attachments for use with cultivators and with the general-purpose tractor.

Harvesting machinery for small grain has probably reached a higher degree of perfection than machinery for harvesting any other crop in the United States. The physical characteristics of such crops as well as the large amount of manual labor originally involved in producing them, were chiefly responsible for the improvements that have been made in grain-harvesting machines.

DUTY OF FARM MACHINES

Probably the simplest method of approximating the duty of a tractor or horse-drawn implement in acres covered per 10-hour day is to multiply the effective width of the implement in feet by the rate of travel in miles per hour. This relation is derived from the following equation (*13*):

$$D=\frac{SW\ 5{,}280\ (100-P)\ 10}{43{,}560\times 100}$$

in which—

D = duty in acres per day.
S = speed in miles per hour.
W = Effective width in feet.
5,280 = number of feet per mile.
P = per cent of time lost in turning and in servicing.
10 = hours worked per day.
43,560 = square feet per acre.

When $P=17.5$, the equation becomes $D=SW$. Increasing the speed or the effective width of an implement does not always increase its duty in the same proportion. This is partly due to the fact that interruptions frequently tend to be more or less proportional to the area covered, especially with row-crop implements. Very seldom is it possible to cover twice the acreage with a 2-row implement as with a 1-row implement when pulled at the same speed. The shape and size of fields, as well as the topography, type of soil, and type of power used, also influence the duty of such equipment. When a tractor is used, the duty per foot of width of an implement is usually greater than when horses are used. This is because the implement is usually pulled at a greater rate of speed with a tractor than with horses.

APPENDIX

STATISTICS RELATING TO TRACTORS, HORSES AND MULES, AND CERTAIN FARM CONVENIENCES

TABLE 16.—*Gas tractors manufactured in the United States and sold, 1909–1930* [1]

Year	Number manufactured [2]					Sold in United States					Sold for export [3]				
	Wheel and track-laying types			Garden tractors [4]	Motor cultivators [4]	Wheel and track-laying types			Garden tractors [4]	Motor cultivators [4]	Wheel and track-laying types			Garden tractors [4]	Motor cultivators [4]
	Wheel	Track-laying	Total			Wheel	Track-laying	Total			Wheel	Track-laying	Total		
1909			2,000												
1910			4,000												
1911			7,000												
1912			11,500												
1913			7,000												
1914			15,000												
1915			21,000												
1916			29,670					27,819							
1917			62,742					49,504					14,854		
1918			132,697					96,470					36,351		
1919			164,590					136,162					19,693		
1920			203,207		1,120			162,988		865			29,143		20
1921			68,029	5,169	1,611					1,602					1
1922	94,607	4,187	98,794	898	1,560	96,426	3,666	100,092	1,100	1,152	9,497	726	10,223	9	21
1923	126,906	5,002	131,908	2,682	1,994	110,690	4,350	115,040	2,661	2,384	15,793	815	16,608	35	16
1924	[5] 112,226	4,612	116,838	2,505		92,232	4,407	96,639	2,372		24,649	945	25,594	28	
1925	158,037	6,060	164,097		3,456	114,160	4,579	118,739		3,259	45,073	703	45,776		148
1926	170,302	7,772	178,074		3,921	116,929	6,011	122,940		3,785	46,441	1,164	47,605		121
1927	184,594	10,319	194,913		5,591	147,123	8,720	155,843		4,794	41,998	(6)			134
1928	152,266	19,203	171,469		4,465	86,930	12,890	99,820		4,073	(6)	(6)			164
1929	195,980	27,101	223,081		5,895	136,310	19,000	155,310		4,732	51,318	(6)			582
1930	176,075	20,222	196,297		6,161	113,160	15,105	128,265		4,484	43,666	(6)			519

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[1] Some steam tractors may be included in number manufactured 1909–1915.

[2] Figures 1909–1915 estimated. Data for 1916–1920 collected by U. S. Department of Agriculture (U. S. Dept. Agri. Circ. 212 (*17*)); data for 1921–1930 collected by U. S. Department of Commerce.

[3] Sales data incomplete for 1916, 1921, 1927, 1928, 1929, and 1930.

[4] Motor cultivators not shown in 1924; Combined with garden tractors 1925–1930.

[5] Total number of wheel-type tractors manufactured in 1924 changed in 1925 census report by addition of 38 tractors.

[6] Not shown in census reports.

TABLE 17.—*Number of tractors of different types manufactured in the United States 1916–1930, inclusive* [1]

Type wheel	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
Belt—horsepower rating—															
5 but less than 10 [2]						340									
8 and less [2]	15	25		3,760	7,678		756								
9 and less								2,761							
9 to 15	1,265	8,632	1,141	1,991	3,366	412									
9 to 18							80,631								
10 to 14								676							
10 but less than 20						12,419									
15 to 19								102,126							
16 to 18	10,102	9,200	20,629	22,012	107,782	976									
19 to 22	9,714	23,841	72,238	94,653	39,964	353	5,245								
Under 20									87,161	106,870	93,884				
20 to 24								9,540	13,271	21,153	29,569				
20 but less than 30						46,392									
23 to 26	3,067	9,847	20,616	15,546	18,073	1,762	608								
Under 25												136,349	72,713		100.886
25 to 29								2,704	1,529	8,283	14,483	17,275	23,087		27,500
Under 30														128,360	
27 to 32	1,459	3,279	6,959	17,597	19,861	241	6,031								
30 to 39								7,673	9,219	20,102	29,712	27,674	53,801	65,797	34,796
30 but less than 40						3,129									
33 to 39	1,003	1,498	2,212	2,453	1,410	156	239								
40 to 49								1,095	870	1,099	2,328	2,840	1,878	1,543	12,413
40 but less than 50						523									
40 to 59	1,587	2,270	1,331	1,954	3,684	718	738								
50 but less than 100						477									
50 and over								331	138	530	326	456	787	280	480
60 and over	1,123	1,774	913	1,624	1,389	109	359								
100 but less than 500						22									
Total [3]							94,607	126,906	[4] 112,226	158,037	170,302	184,594	152,266	195,980	176,075
Garden						5,169	898	2,682	2,505	3,456	3,921	5,591	4,465	5,895	6,161
Motor cultivators [5]					1,120	1,611	1,560	1,994							
Track-laying							4,187	5,002	4,612	6,060	7,772	10,319	19,203	27,101	20,222
Total [6]	29,670	62,742	132,697	164,590	204,327	74,809	101,252	136,584	119,343	167,553	181,995	200,504	175,934	228,976	202,458

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[1] Data for 1916–1920 collected by U. S. Department of Agriculture (see U. S. Dept. Agr. Circ. 212 (*17*)). Data for 1921–1930 collected by U. S. Department of Commerce, Manufacture and Sale of Farm Equipment (*20*).

[2] May include some garden tractors and motor cultivators.

[3] Wheel and track-laying types not shown separately before 1922.

[4] Change in 1924 data made in 1925 report by the addition of 38 tractors, not shown by sizes.

[5] Motor cultivators not shown in 1924; combined with garden tractors 1925–1930.

[6] Includes some tractors not shown by sizes, 1916–1919.

TABLE 18.—*Number of gas tractors of different types sold in the United States and for export, 1922–1930* [1]

Type	1922		1923		1924		1925		1926		1927		1928		1929		1930	
	Sold in United States	Sold for export	Sold in United States	Sold for export	Sold in United States	Sold for export	Sold in United States	Sold for export	Sold in United States	Sold for export	Sold in United States	Sold for export	Sold in United States	Sold for export	Sold in United States	Sold for export	Sold in United States	Sold for export
Wheel:																		
Belt horsepower rating—																		
8 and less [2]	544	82																
9 and less			1, 636	1, 308														
9 to 18	79, 719	6, 801																
10 to 14			774	85														
15 to 19			91, 295	10, 831														
19 to 22	8, 787	897																
Under 20					67, 964	19, 894	73, 828	33, 853	61, 848	31, 072								
20 to 24			8, 022	1, 001	12, 281	2, 386	17, 234	4, 322	22, 618	5, 300								
23 to 26	907	383																
Under 25											109, 234	27, 356	42, 743	17, 117			74, 331	(3)
25 to 29			2, 072	682	2, 279	241	6, 567	1, 441	11, 428	2, 254	13, 786	4, 058	16, 916	5, 657			15, 956	(3)
Under 30															99, 105	27, 850		
27 to 32	4, 773	1, 232																
30 to 39			5, 831	1, 733	8, 572	2, 019	15, 196	5, 273	18, 855	7, 428	21, 397	9, 953	25, 630	21, 781	36, 013	23, 120	18, 083	13, 617
33 to 39	285	5																
40 to 49			725	130	939	100	903	144	1, 933	356	2, 325	(3)	1, 143	602	899	339	4, 439	6, 471
40 to 59	1, 039	84																
50 and over			335	23	197	9	432	40	247	31	381	(3)	498	(3)	293	(3)	351	(3)
60 and over	372	13																
Total	96, 426	9, 497	110, 690	15, 793	92, 232	24, 649	114, 160	45, 073	116, 929	46, 441	147, 123	41, 998	86, 930	(3)	136, 310	51, 318	113, 160	43, 666
Garden	1, 100	9	2, 661	35	2, 372	28	} 3, 259	148	3, 785	121	4, 794	134	4, 073	164	4, 732	582	4, 484	519
Motor cultivators [4]	1, 152	21	2, 384	16														
Track-laying	3, 666	726	4, 350	815	4, 407	945	4, 579	703	6, 011	1, 164	8, 720	(3)	12, 890	(3)	19, 000	(3)	15, 105	(3)
Total	102, 344	10, 253	120, 085	16, 659	99, 011	25, 622	121, 998	45, 924	126, 725	47, 726	160, 637	(3)	103, 893	(3)	160, 042	(3)	132, 749	(3)

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[1] Manufacture and Sale of Farm Equipment (*20*) published annually by the Bureau of the Census, U. S. Department of Commerce.
[2] May include some garden tractors and motor cultivators.
[3] Not shown in census reports.
[4] Motor cultivators not shown in 1924; combined with garden tractors from 1925–1930.

TABLE 19.—*Approximate rated belt horsepower of wheel-type gas tractors sold in the United States, 1922–1930*

Belt horsepower rating	Estimated average belt horsepower	1922		1923		1924		1925		1926		1927		1928		1929		1930	
		Number sold	Total belt horsepower	Number sold	Total belt horsepower	Number sold	Total belt horsepower	Number sold	Total belt horsepower	Number sold	Total belt horsepower	Number sold	Total belt horsepower	Number sold	Total belt horsepower	Number sold	Total belt horsepower	Number sold	Total belt horsepower
Under 20	[1] 17	88,506	1,504,602	92,069	1,565,173	67,964	1,155,388	73,828	1,255,076	61,848	1,051,416								
20 to 24	22			8,022	176,484	12,281	270,182	17,234	379,148	22,618	497,596								
23 to 26	24.5	907	22,222																
Under 25	20											109,234	2,184,680	42,743	854,860			74,331	1,486,620
Under 30	21															99,105	2,081,205		
25 to 29	27			2,072	55,944	2,279	61,533	6,567	177,309	11,428	308,556	13,786	372,222	16,916	456,732			15,956	430,812
27 to 32	29.5	4,773	140,804																
30 to 39	34.5			5,831	201,170	8,572	295,734	15,196	524,262	18,855	650,498	21,397	738,196	25,630	884,235	36,013	1,242,449	18,083	623,863
33 to 39	36	285	10,260																
40 to 49	44.5			725	32,262	939	41,786	903	40,184	1,933	86,018	2,325	103,462	1,143	50,864	899	40,005	4,439	197,535
40 to 59	[2] 49.5	1,039	51,430																
Total		95,510	1,729,318	108,719	2,031,033	92,035	1,824,623	113,728	2,375,979	116,682	2,594,084	146,742	3,398,560	86,432	2,246,691	136,017	3,363,659	112,809	2,738,830
Average rating			18.1		18.7		19.8		20.9		22.2		23.2		26.0		24.7		24.3

[1] Tractors rated in 1922 at 8 belt horsepower and less, and in 1923 at 9 and less, are omitted. The 19-to-22-horsepower group in 1922, is included in the under-20 group.

[2] Tractors rated at 50 horsepower and over, omitted in all years except 1922, in which year tractors of 50 to 59 horsepower were grouped with those of 40 to 59 horsepower.

TABLE 20.—*Number of tractors, horses, and mules on farms in each State, 1920, 1925, and 1930* [1]

State	Tractors [2]			Horses and mules [2]					
				Two years old and over			Total, all ages		
	1920	1925	1930	1920	1925	1930 [3]	1920	1925	1930
Maine	635	1, 774	3, 410	91, 111	81, 346	61, 078	94, 794	82, 664	61, 482
New Hampshire	207	531	1, 096	36, 921	31, 268	20, 093	38, 442	31, 740	20, 267
Vermont	444	1, 568	2, 426	73, 253	61, 982	52, 066	77, 832	63, 504	52, 803
Massachusetts	592	2, 212	3, 921	49, 275	43, 473	24, 809	50, 937	44, 062	25, 069
Rhode Island	79	318	589	6, 418	5, 402	3, 209	6, 615	5, 461	3, 266
Connecticut	440	1, 441	2, 667	38, 025	34, 551	21, 110	38, 994	34, 937	21, 253
New York	7, 497	25, 681	40, 369	516, 944	439, 366	321, 577	543, 494	447, 265	326, 309
New Jersey	946	4, 419	8, 088	76, 268	61, 170	42, 349	78, 326	62, 103	42, 753
Pennsylvania	5, 697	19, 764	33, 513	525, 426	449, 728	356, 474	561, 047	462, 698	362, 403
Ohio	10, 469	30, 905	52, 974	767, 507	634, 223	509, 238	842, 318	662, 843	526, 303
Indiana	9, 230	23, 567	41, 979	718, 390	624, 406	506, 828	817, 591	657, 054	525, 399
Illinois	23, 102	43, 325	69, 628	1, 249, 189	1, 113, 485	915, 205	1, 465, 126	1, 197, 669	954, 307
Michigan	5, 884	19, 217	34, 579	568, 978	474, 593	380, 156	611, 393	489, 420	389, 188
Wisconsin	9, 407	29, 651	50, 173	631, 934	585, 317	539, 024	687, 648	610, 666	553, 270
Minnesota	15, 503	26, 739	48, 457	834, 088	798, 945	790, 336	943, 032	847, 281	820, 311
Iowa	20, 270	37, 230	66, 258	1, 250, 004	1, 162, 783	1, 079, 681	1, 468, 042	1, 276, 830	1, 132, 487
Missouri	7, 889	12, 745	24, 999	1, 043, 046	986, 173	852, 403	1, 295, 265	1, 079, 690	892, 868
North Dakota	13, 006	17, 483	37, 605	719, 384	685, 629	592, 193	863, 555	740, 584	619, 840
South Dakota	12, 939	17, 426	33, 837	672, 881	667, 044	595, 209	832, 151	741, 409	640, 511
Nebraska	11, 100	18, 765	40, 729	878, 815	901, 201	813, 833	1, 061, 243	982, 330	853, 269
Kansas	17, 177	31, 171	66, 275	1, 061, 401	1, 080, 778	817, 627	1, 326, 159	1, 191, 446	866, 330
Delaware	239	694	1, 600	35, 084	31, 000	26, 868	37, 191	31, 947	27, 412
Maryland	1, 525	4, 026	7, 208	159, 382	138, 762	119, 064	173, 962	147, 444	123, 150
Virginia	2, 379	6, 750	9, 757	371, 128	345, 419	287, 843	409, 295	362, 664	297, 747
West Virginia	572	1, 860	2, 792	167, 524	149, 234	120, 871	184, 129	157, 737	124, 958
North Carolina	2, 277	7, 909	11, 426	411, 022	406, 385	379, 489	428, 005	410, 730	381, 024
South Carolina	1, 304	2, 906	3, 462	289, 412	245, 105	218, 978	297, 681	248, 194	219, 392
Georgia	2, 252	4, 145	5, 870	495, 479	395, 287	390, 202	506, 854	398, 052	390, 958
Florida	680	2, 777	5, 244	76, 497	69, 292	61, 349	80, 616	71, 504	62, 216
Kentucky	2, 029	4, 994	7, 322	592, 615	570, 419	482, 991	675, 299	601, 232	500, 205
Tennessee	1, 872	4, 767	6, 865	575, 167	558, 210	480, 868	670, 431	594, 684	493, 942
Alabama	811	2, 465	4, 664	404, 769	381, 414	394, 465	426, 600	390, 172	396, 973
Mississippi	667	1, 871	5, 542	481, 192	442, 484	467, 049	523, 068	458, 931	472, 022
Arkansas	1, 822	3, 476	5, 684	519, 530	504, 348	492, 597	574, 603	522, 843	499, 255
Louisiana	2, 812	3, 482	5, 016	331, 778	292, 884	313, 275	358, 871	304, 827	319, 394
Oklahoma	6, 210	10, 950	25, 962	881, 927	897, 623	783, 731	1, 075, 078	976, 247	820, 973
Texas	9, 048	16, 780	37, 348	1, 662, 551	1, 747, 305	1, 748, 129	1, 837, 294	1, 848, 308	1, 802, 148
Montana	7, 647	6, 602	19, 031	512, 187	515, 569	414, 181	678, 185	604, 625	458, 417
Idaho	1, 587	1, 927	4, 691	243, 261	215, 253	200, 021	300, 858	240, 391	213, 322
Wyoming	1, 075	1, 323	4, 111	146, 935	170, 578	159, 473	201, 710	204, 666	177, 223
Colorado	4, 990	6, 693	13, 334	358, 252	362, 864	333, 279	451, 829	403, 498	358, 468
New Mexico	491	1, 080	2, 497	167, 550	188, 033	150, 796	203, 055	217, 410	164, 058
Arizona	930	1, 239	2, 558	111, 751	105, 113	82, 678	148, 159	123, 735	91, 009
Utah	583	850	1, 426	101, 649	99, 421	87, 319	128, 264	113, 865	94, 124
Nevada	210	221	360	40, 337	45, 195	38, 811	52, 936	54, 312	43, 725
Washington	2, 635	4, 490	8, 388	274, 877	249, 001	196, 762	319, 472	268, 516	204, 677
Oregon	3, 070	5, 768	9, 838	234, 873	219, 742	179, 222	285, 934	242, 910	192, 330
California	13, 852	29, 948	44, 437	416, 267	349, 680	256, 404	465, 826	370, 141	266, 873
District of Columbia	1	8	17	340	261	173	343	279	173
Total	246, 083	505, 933	920, 021	21, 872, 594	20, 618, 744	18, 161, 386	25, 199, 552	22, 081, 520	18, 885, 856

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[1] Figures for 1930 subject to revision.

[2] Bureau of the Census, U. S. Department of Commerce.

[3] May include some animals less than 2 years old.

TABLE 21.—*Number of farms, of automobiles and trucks on farms, and of certain farm facilities, 1920 and 1930, by States*[1]

State	Number of farms		Number of—			
			Automobiles		Trucks	
	1920	1930	1920	1930	1920	1930
Maine	48, 227	39, 006	12, 569	26, 227	1, 120	10, 781
New Hampshire	20, 523	14, 906	5, 263	11, 079	717	4, 539
Vermont	29, 075	24, 898	8, 172	18, 620	616	5, 035
Massachusetts	32, 001	25, 598	9, 309	17, 638	3, 535	9, 572
Rhode Island	4, 083	3, 322	1, 395	2, 569	536	1, 701
Connecticut	22, 655	17, 195	8, 046	13, 154	1, 595	6, 344
New York	193, 195	159, 806	74, 753	141, 916	9, 259	58, 974
New Jersey	29, 702	25, 378	13, 695	22, 371	3, 380	14, 753
Pennsylvania	202, 250	172, 419	76, 491	152, 222	9, 372	47, 062
Ohio	256, 695	219, 296	128, 384	201, 552	7, 319	39, 210
Indiana	205, 126	181, 570	102, 122	154, 556	3, 671	30, 037
Illinois	237, 181	214, 497	139, 090	192, 873	6, 154	40, 371
Michigan	196, 447	169, 372	82, 437	150, 922	4, 886	36, 768
Wisconsin	189, 295	181, 767	98, 825	176, 764	4, 044	51, 786
Minnesota	178, 478	185, 255	107, 824	185, 717	3, 803	36, 557
Iowa	213, 439	214, 928	177, 558	240, 512	8, 910	32, 669
Missouri	263, 004	255, 940	86, 229	176, 466	5, 059	20, 132
North Dakota	77, 690	77, 975	47, 711	78, 798	774	16, 990
South Dakota	74, 637	83, 157	58, 202	81, 923	4, 353	14, 816
Nebraska	124, 417	129, 458	104, 453	141, 144	6, 548	26, 045
Kansas	165, 286	166, 042	111, 055	171, 018	3, 928	33, 648
Delaware	10, 140	9, 707	4, 014	8, 724	304	2, 996
Maryland	47, 908	43, 203	17, 702	37, 972	2, 805	11, 284
District of Columbia	204	104	58	60	29	81
Virginia	186, 242	170, 610	30, 959	88, 463	2, 544	19, 459
West Virginia	87, 289	82, 641	11, 127	36, 978	936	7, 432
North Carolina	269, 763	279, 708	44, 207	132, 876	2, 671	18, 558
South Carolina	192, 693	157, 931	32, 812	61, 754	1, 736	6, 966
Georgia	310, 732	255, 598	49, 841	88, 479	3, 145	15, 967
Florida	54, 005	58, 966	9, 383	26, 387	1, 617	12, 203
Kentucky	270, 626	246, 499	30, 146	86, 784	1, 538	7, 188
Tennessee	252, 774	245, 657	23, 550	89, 022	1, 430	9, 039
Alabama	256, 099	257, 395	16, 592	73, 634	1, 180	12, 838
Mississippi	272, 101	312, 663	15, 853	85, 563	1, 005	16, 503
Arkansas	232, 604	242, 334	16, 408	65, 935	1, 027	11, 000
Louisiana	135, 463	161, 445	10, 512	43, 082	874	9, 281
Oklahoma	191, 988	203, 866	52, 063	127, 448	2, 155	23, 930
Texas	436, 033	495, 489	105, 292	300, 176	5, 399	52, 580
Montana	57, 677	47, 495	22, 072	38, 166	1, 225	14, 615
Idaho	42, 106	41, 674	17, 646	33, 966	837	6, 281
Wyoming	15, 748	16, 011	6, 705	12, 824	591	4, 108
Colorado	59, 934	59, 956	30, 830	52, 258	3, 016	16, 918
New Mexico	29, 844	31, 404	6, 018	15, 395	593	5, 328
Arizona	9, 975	14, 173	5, 082	9, 916	581	3, 062
Utah	25, 662	27, 159	8, 657	17, 574	572	4, 189
Nevada	3, 163	3, 442	1, 717	2, 921	174	1, 241
Washington	66, 288	70, 904	29, 792	55, 995	3, 371	18, 836
Oregon	50, 206	55, 153	22, 223	47, 440	1, 819	9, 741
California	117, 670	135, 676	71, 518	136, 842	6, 416	40, 971
United States	6, 448, 343	6, 288, 648	2, 146, 362	4, 134, 675	139, 169	900, 385

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[1] From the 1920 and 1930 reports of the Bureau of the Census.

Table 21.—*Number of farms, of automobiles and trucks on farms, and of certain farm facilities, 1920 and 1930, by States*—Continued

State	Number of farms having—					
	Telephones		Water piped into dwellings		Dwellings lighted by—	
	1920	1930	1920	1930	Gas or electricity, 1920	Electricity, 1930
Maine	23, 632	22, 189	18, 020	19, 121	4, 625	12, 920
New Hampshire	10, 166	9, 313	10, 765	10, 995	2, 322	6, 160
Vermont	16, 752	15, 093	18, 301	18, 013	3, 328	7, 565
Massachusetts	16, 537	16, 581	16, 893	19, 083	9, 062	16, 037
Rhode Island	1, 685	1, 742	1, 451	1, 887	700	1, 910
Connecticut	11, 738	11, 366	9, 524	10, 716	3, 963	9, 063
New York	91, 973	78, 185	45, 487	59, 276	24, 882	55, 019
New Jersey	9, 484	10, 373	7, 047	12, 359	4, 551	13, 441
Pennsylvania	87, 887	73, 321	46, 402	64, 064	30, 669	45, 638
Ohio	159, 478	121, 214	41, 531	64, 104	37, 745	56, 740
Indiana	136, 140	110, 333	23, 476	35, 451	20, 584	30, 335
Illinois	173, 572	147, 672	26, 676	42, 391	23, 273	34, 231
Michigan	97, 874	73, 757	29, 729	40, 872	15, 695	34, 785
Wisconsin	111, 798	107, 486	13, 465	28, 454	16, 574	46, 565
Minnesota	110, 568	114, 693	11, 392	23, 124	13, 539	23, 342
Iowa	183, 852	180, 876	33, 851	51, 635	32, 552	46, 042
Missouri	163, 543	137, 712	11, 901	21, 308	14, 341	20, 223
North Dakota	36, 349	31, 878	4, 684	5, 844	4, 518	6, 192
South Dakota	44, 327	44, 608	9, 157	12, 089	6, 445	9, 070
Nebraska	95, 050	93, 888	20, 691	38, 357	12, 062	21, 380
Kansas	128, 753	120, 890	15, 339	28, 045	14, 390	20, 720
Delaware	2, 763	2, 420	752	1, 500	397	1, 561
Maryland	11, 755	11, 935	6, 702	10, 354	3, 330	9, 145
District of Columbia	67	69	51	48	52	67
Virginia	33, 482	30, 418	9, 474	15, 291	7, 874	13, 009
West Virginia	37, 789	28, 117	4, 974	9, 650	12, 900	5, 330
North Carolina	33, 029	19, 852	4, 423	9, 308	7, 816	15, 006
South Carolina	10, 943	6, 357	3, 443	5, 176	5, 170	6, 067
Georgia	29, 861	14, 771	5, 615	7, 877	5, 826	7, 499
Florida	4, 524	3, 525	3, 341	7, 559	2, 042	6, 489
Kentucky	73, 145	61, 631	5, 139	8, 378	5, 925	10, 691
Tennessee	56, 880	45, 205	4, 890	8, 018	4, 554	10, 010
Alabama	38, 407	19, 510	2, 987	5, 182	8, 345	6, 459
Mississippi	28, 260	15, 858	2, 983	5, 593	2, 896	4, 792
Arkansas	52, 869	25, 046	1, 780	3, 690	2, 643	5, 121
Louisiana	8, 599	6, 106	2, 185	4, 964	1, 471	4, 174
Oklahoma	71, 613	53, 149	6, 646	10, 820	7, 010	8, 091
Texas	140, 234	97, 346	38, 580	68, 902	8, 228	22, 854
Montana	9, 781	9, 697	3, 055	5, 382	2, 013	3, 547
Idaho	13, 837	15, 733	5, 240	9, 970	5, 982	12, 809
Wyoming	4, 449	4, 483	1, 035	1, 995	717	1, 145
Colorado	22, 022	23, 877	6, 806	12, 314	3, 925	9, 393
New Mexico	3, 359	2, 879	1, 460	2, 804	422	1, 691
Arizona	1, 638	2, 672	1, 988	4, 083	592	3, 671
Utah	6, 295	7, 416	6, 179	10, 561	11, 125	15, 778
Nevada	1, 122	1, 460	580	1, 215	385	1, 139
Washington	27, 952	31, 764	18, 967	34, 476	9, 178	34, 056
Oregon	25, 351	26, 557	12, 914	24, 265	5, 463	18, 397
California	37, 309	48, 171	65, 928	97, 639	30, 519	85, 941
United States	2, 498, 493	2, 139, 194	643, 899	994, 202	452, 620	841, 310

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